

**SPECIFICATIONS AND DRAWINGS
FOR THE
PHASE IIA CONSTRUCTION
(PROCESS TREATMENT SYSTEM)
REMEDIAL ACTION 881 HILLSIDE, 881
ROCKY FLATS PLANT
GOLDEN, COLORADO**

Prepared for
EG&G ROCKY FLATS, INC.

December 1990

Prepared by:
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1100 Stout Street, Suite 1100
Denver, Colorado 80204

In Conjunction with
**THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA**

ADMIN RECORD
R1-7-21

REVIEWED FOR CLASSIFICATION/UCNI

By *R. P. Delaney*
Date *12/4/91*

"REVIEWED FOR CLASSIFICATION

By *TPB*

Date *12-18-90*

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SECTION 01100
SPECIAL CONTRACT REQUIREMENTS

01101 LOCATION OF WORK

The work covered by this contract will be performed at the Rocky Flats Plant, near Golden, Colorado. (See Location Map and Area Plot Plan the end of Section 01500.) This facility is one which is owned by the Government and operated on behalf of the DOE by EG&G Rocky Flats, Inc.

01102 SCOPE OF WORK, PERFORMANCE OF WORK BY CONTRACTOR

This contract covers the furnishing of all plant, labor, equipment, supplies and materials, and performing all work in strict accordance with the terms of the contract.

Phase IIA Construction of the 881 Hillside Remedial Action project includes the following facilities:

- Process treatment system, including electrical and controls.
- Indoor and outdoor transfer piping.
- Tank electrical and controls.
- Chemical storage and transfer facilities.
- Completion of Building 891 electrical and outdoor lighting.
- Installation of a UV/peroxide treatment unit and ion exchange treatment system, which are Government Furnished Equipment under separate contract.

The Contractor will be required to interface with and utilize other facilities which have been constructed under other Phases of 881 Hillside Remedial Action. These include:

- Pre-engineered Building 891 and foundation.
- Influent storage tanks and foundation.
- Water supply pipeline, sewer pipeline, natural gas service pipeline, electrical service and telephone service to Building 891.
- Building 891 HVAC, plumbing and electrical.

In addition, three 159,000 gallon effluent storage tanks and foundations are to be designed and constructed as a separate GFE contract. The Contractor will be required to coordinate closely with the tank manufacturer during execution of this work.

The following construction activities will be performed under Phase IIB of the project and are not a part of this work:

- Influent collection gallery, sumps, wells, pipeline, and electrical.
- Effluent discharge line and structure.
- Final grading and landscaping.

The contractor shall perform on the site and with his own employees work equivalent to at least 15% of the total dollar amount of work to be performed under the contract, not including the cost of materials. If during the progress of the work hereunder, the Contractor requests a reduction in such percentage and the Buyer determines that it would be to the Buyer's advantage, he may, in writing, authorize a reduction.

01103 CONTRACT DRAWINGS AND SPECIFICATIONS

The Contractor will be furnished, without charge, 10 sets of specifications and half-sized drawing and one full-size set of reproducibles. The drawings which constitute a part of the contract documents are as indexed at the end of these specifications.

The Contractor shall observe and so caution any Sub-contractor, that the scales on the half-sized drawings are not necessarily correct and may not be directly usable for material take-offs.

01104 ABBREVIATIONS

Abbreviations contained in various sections of the specifications refer to the following organizations, societies, associations, standards, publications terms, etc.

01105 SECURITY MEASURES

- a. The Contractor shall furnish to the Buyer a letter listing all contractor organizations; any deviations from the normal workday or workweek at the Rocky Flats Plant; The contractor shall fill out a gate pass form (RF-34660) furnished by the Buyer for all Contractor and Subcontractor personnel requiring access to specified construction areas. Access will be granted for the period of performance of work. The Buyer shall be notified of the termination of employment of individuals submitted for access. The Buyer

reserves the right to exclude from the worksite any employee as deemed appropriate. Access to the plantsite will not be granted to persons who are not citizens of the United States of America.

1. When the duration of construction is 30 days or less, the Buyer shall issue each Contractor individual nonpicture security badges (passes) and parking permits for access to the plant. These badges and parking permits are accountable property of the U.S. Government and shall be returned to the designated gate at the end of each day.
2. When the duration of construction is 30 days or more, the Buyer shall issue each Contractor individual picture security badges (passes) and parking permits for access to the plant. These badges and parking permits are accountable property of the U.S. Government and shall be returned upon the completion of the project.
3. The failure of the Contractor to return all badges and parking permits could result in a delay of contract closing and the withholding of \$500 from the final payment for each missing badge and parking pass.
4. The Buyer's subcontract Administrator shall be notified immediately of any missing or lost badges and parking permits.
5. The Buyer's Plant Protection Department will immediately report to the Buyer's Subcontractor Administrator any individual nonpicture security badge and parking permit not returned to the designated gate at the end of the day.

01106 HEALTH SCIENCES MEASURES

- a. All work under this contract will be performed in areas subject to Rocky Flats Health, Safety & Environment rules and regulations as specified below.

All persons requiring access to these areas will be subjected to lectures and administrative actions which are estimated to take approximately 16 hr per man. All costs for the time involved as a result of these actions shall be borne by the Contractor, whether it involves more or less time than that estimated above.

- b. Reimbursement for Equipment Retained by the Buyer

1. Tools and equipment shall be monitored prior to being removed from construction areas.

01100-3

2. Any tools or equipment which are determined by the Buyer to be unsuitable for future use after having been monitored by the Buyer's Radiation Monitoring personnel will be retained by the disposition made by the Buyer.
3. Reasonable compensation will be made for any tools or equipment which are retained by the Buyer. The Contractor shall immediately notify the Buyer in writing of the value which he places on the tools and/or equipment and the basis for such valuation.

c. Specific Requirements

1. Protective clothing required for Contractor's nonworking supervisory personnel entering areas for short periods will be shoe covers, respirators, safety glasses, smocks and dosimetry badges.
2. All persons required to wear protective clothing will be required to take a shower at the close of each work day in shower facilities provided by the Buyer. Towels and lockers will be furnished by the Buyer.
3. Food, beverages and tobacco are not permitted in the construction areas of this project.
4. Radiation Monitoring coverage will be provided by the Buyer on an as-required basis, except that a radiation monitor will be present during all demolition or removal operations.
5. The Buyer will furnish lockable boxes to the construction site for the disposal of materials that are determined to emit radionuclides. The Contractor shall place materials so designated in these boxes. Waste boxes will be kept locked and stored inside buildings.
6. No pregnant females shall be permitted in radiation controlled areas.
7. A continuously recording anemometer, with high level audible alarm and warning light set at 15 mph, will be required during excavation activities.

8. Contamination Health and Safety Requirements

a. Occupational Medical Examination

Prior to work on the site, all personnel must have a physical for hazardous waste workers which meets the requirements as addressed in SARA and OSHA. The physical examination must have been in the last 12 months and included a medical screening for the use of respiratory protective devices. In addition, all workers will be required to have heavy metals blood and urine screening. Frequency of the screening will be prior to start of work, yearly at the request of the Buyer, and at end of the job. The Contractor shall provide to the Buyer a signed statement from the physician certifying that the employee has had the required medical examination and is fit for hazardous waste site work prior to work on the site. The statement shall include any work restrictions required by the physician.

b. Work Clothing

Adequate dress for personnel on the site shall consist of the following:

1. Full-length trousers/slacks/jeans.
2. Sturdy work shoes or boots, footwear meeting the requirements of ANSI Standards Z41, where heavy objects must be worked with or lifted.
3. Shirts that cover the shoulders, with sleeves at least T-shirt length. Tank tops, shirts cut off at the midriff, cutoff pants, moon boots, sandals, sneakers, and jogging shoes are considered unacceptable dress and will not be permitted at any Buyer-controlled work site.
4. Hard hats that meet the requirements of ANSI Standard Z-89.1.
5. Safety glasses with side shields that comply with requirements of ANSI Standard Z-87.1.

c. Access Control Points.

1. Access to controlled areas shall be controlled through a designated Access Control point. Workers leaving the controlled area shall be monitored for contamination under the direct supervision of the on-site Radiological Protection Technologist. Workers shall decontaminate their work clothes and/or wash their faces and hands if necessary as directed by the appropriate Health and Safety Representative of the Buyer.
2. Emergency phone numbers, route to site medical facilities and the OSHA poster shall be prominently posted at the Access Control Point by the Contractor.
3. If decontamination of clothing does not adequately remove contaminated material, the Buyer will provide the wearer with a clean pair of coveralls, and will have the contaminated clothing cleaned. In the event that the clothing cannot be satisfactorily cleaned, the Buyer will reimburse the Contractor for the value of the item if the worker was in compliance with contamination control requirement for the site at the time of the incident.

01107 PLAN OF OPERATIONS

There will be no stipulated sequence of construction. The Contractor shall arrange his schedule such that, when work is started, work will proceed promptly and vigorously to completion. The Buyer may require the Contractor to show satisfactory proof that materials, equipment, workers, etc., are or will be available as required to complete the work without undue delay. Normal working hours for Contractor shall be 8:00 a.m. to 4:30 p.m. unless otherwise noted.

01100-6

01108 QUALIFICATIONS FOR FIRE PROTECTION SYSTEM INSTALLERS

The fire protection system shall be installed by a recognized fire sprinkler company which has been regularly engaged in the design and installation of systems of similar kind and scope as that required herein. The sprinkler system shall be designed by a N.I.C.E.T. (National Institute of Certification of Engineering Technology), certified designer, level III or higher. In lieu of the NICET rating, the system will be designed under the direction of a licensed professional engineer. No subcontract for the fire protection system shall be awarded without the prior written approval of the Buyer.

Such approval will be given upon a showing that the proposed Subcontractor meets the above-stated qualifications.

01109 HEALTH AND SAFETY

In addition to the requirements of Special Provisions No. 3 and GP-56, the following safety items will be emphasized and enforced:

- a. Ladders
 1. No three-legged ladders will be allowed.
 2. No wooden ladders will be allowed in any building.
 3. Aluminum ladders will not be allowed for work in areas where there is electrical power equipment or in Building 891.
 4. Industrial fiberglass ladders will be allowed.
- b. All contractors shall comply with NFPA 241 (Safeguarding Building Construction and Demolition Operations).
- c. All workmen will be required to wear hard hats. All visitors to posted construction areas will be required to wear hard hats.
- d. All compaction performed with vibratory equipment will be performed by workmen wearing approved foot protection devices.
- e. All Contractor personnel will wear shirts, long pants and shoes on the plantsite.
- f. A lift device known as the "Xtraman Hoist" or any lifting devices where, by design, the operator or any other person is used as the ballast or counterweight of the device is not to be used on construction projects at the Rocky Flats Plant.

- g. Smoking restriction shall be as posted.
- h. Safety meetings shall be held weekly.

01110 MEDICAL RADIOISOTOPE PROCEDURES ON CONTRACTOR PERSONNEL

All persons engaged in construction at the Rocky Flats Plant are required to report any diagnostic or therapeutic treatment with radioisotopes to the Buyer. Personnel should report prior to treatment, if possible, or immediately after such treatment when they return to work.

01111 ROOF PROTECTION

Personnel requiring access to the roofs of various buildings shall comply with the following requirements:

- a. Temporary walkways will be installed to and around any work areas.
- b. Material will not be set on the roof surface unless suitable protection is provided for the roof surface.
- c. All scrap and excess material must be removed daily when the work or exercise is complete.

01112 PRIVATELY OWNED RADIO PAGERS

Security regulations do not allow the use of privately owned radio pagers at the rocky Flats Plant except in areas designated as "controlled," such as the warehouse, maintenance shops, garage, etc. Pagers must also be left in privately owned vehicles when entering any area that is not a "controlled" area.

01113 HOLIDAY WORK CURTAILMENT

During the holiday periods covering the days April 13, 1990, May 28, 1990, July 4 1990, September 3, 1990, November 22, 1990 through November 23, 1990 and from December 25, 1990 through January 1, 1991, Construction Contractor activities will be suspended. Contractors and their Subcontractors shall plan their work accordingly. Access to the plantsite during these time periods will be by special arrangement with the Buyer only.

01114 USE OF FIRE RETARDANT MATERIALS

The Contractor shall use fire retardant materials in construction which are specified in applicable divisions of Technical Provisions.

END OF SECTION 01100

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SECTION 01300
SUBMITTALS

01301 GENERAL (Refer to GP-59)

- a. Descriptive submittals shall be made for all items of equipment set forth in the tables at the end of this section or such other items as may be identified during the design phase of the Contract. Submittals marked with an asterisk must be in reproducible form, the same size and scale as the Contract drawings, or as directed. The Contractor shall submit eight complete sets for each submittal item, except fire equipment items which will require ten complete sets.
- b. Omissions of items from the submittal table does not relieve the Contractor from the responsibility for submitting vendor data for any other applicable items that would normally require such submittals. The most closely related item listed will govern the type of submittals required.
- c. If required, samples and descriptive data shall be submitted, within the time specified in these specifications, or if no time is specified, within a reasonable time before use to permit inspection and testing; and shall be delivered as specified in these specifications and shall be properly marked to show the name of the material, trade name of manufacturer, place of origin, name and location of work where the material represented by the sample is to be used, and name of Contractor submitting the sample. Samples not subject to destructive tests may be retained until completion of the work, but thereafter will be returned to the Contractor, if he so requested in writing, at his own expense. Failure of any samples to pass the specified requirements will be sufficient cause for refusal to consider further any samples from the same manufacturer whose materials failed to pass the tests.
- d. Catalogs for submittal shall have unrelated pages removed with capacities and specified parameters relating to the item or items clearly marked.
- e. All items which form a system or subsystem that must be reviewed simultaneously because of coordination requirements shall be submitted concurrently.
- f. The Contractor shall also furnish the Buyer with five copies of instruction books covering handling, storage, installation, operation, maintenance, and spare parts provisioning for any equipment being furnished under this contract. These instruction books will be required 30 days prior to shipment of the equipment.

- g. If the Contractor fails to submit for approval the required data within the specified time, the Buyer will select a complete line of materials and/or equipment. If the Contractor submits for inclusion in the work materials and/or equipment not in accordance with the specifications, the Buyer will have the right to reject them and select a full line of materials and/or equipment. The selection made by the Buyer will be final and binding, and the items shall be furnished and installed by the contractor without change in the contract price.
- h. All submittals shall be correct to Buyer requirements prior to the completion of the project and turned over to the Buyer.
- i. Each submittal of drawings and data by the Contractor shall be accompanied by a letter of transmittal giving list of number, titles of drawings, status (Revision Number and Date), action to be taken, and five properly executed copies of the Drawing Transmittal Form attached hereto.

Address to: EG&G Rocky Flats, Inc.
Rocky Flats Plant, Building 131
P. O. Box 464
Golden, Colorado 80401-0464

- j. Contractor shall further supplement the transmittal letter, if necessary, with other needed data clarifications. All prints, reproducibles, and material submitted shall be stamped with the transmittal number. The Buyer will furnish blank copies of drawing transmittal forms for use by the Contractor.

01392 REVIEW OF SUBMITTALS

- a. After receiving submittals, the Buyer will promptly examine the drawings and/or data only for general arrangement, general dimensions, and suitability and will approve them or return them with comments. This approval shall not relieve the Contractor of his responsibility for sufficiency of detail, design, or correctness of detailed dimensions.
- b. Approval of descriptive submittals will not relieve the Contractor of the responsibility for correcting any errors which may exist or for meeting requirements of the specifications. No partial submittals will be accepted.
- c. The Buyer will return reviewed submittal data to the Contractor within ten working days after receipt of each submittal. The Contractor shall schedule sufficient time in the procurement process for such review.

01300-2

- d. Within 10 days of receipt of returned submittals with comments, the Contractor shall revise and resubmit for approval in the same quantity and in like manner stated above.

LEGEND

- a. Shop Drawings
- b. Catalog Data
- c. Equipment List
- d. Material List
- e. Elementary Diagrams and Wiring Diagrams
- f. Installation Instructions
- g. Maintenance Instructions
- h. Operating Instructions
- i. Samples, Colors
- j. Certifications
- k. Performance Curves
- l. Design Data
- m. Recommended Spare Parts Lists
- n. Computations
- o. Theory of Operation
- p. Demolition Procedure

SUBMITTAL TABLE

Waste Handling Plant

- e. The Contractor shall submit all forms, data, information, certificates, schedules, etc., as required in other sections of the specifications. Omission of an item from the above tabulation does not relieve the Contractor from the responsibility for submitting the item required.
- f. Complete submittals are required for all items of equipment or materials submitted for "as-equal" consideration. If the Contractor submits a letter stating that he is installing the exact material, equipment, or model number called out in the specifications, no submittal is required.

END OF SECTION 01300

SECTION	DESCRIPTION	a. Shop Drawings	b. Catalog Data	c. Equipment List	d. Material List	e. Elementary Diagrams & Wiring Diagrams	f. Installation Instructions	g. Maintenance Instructions	h. Operating Instructions	i. Samples, Colors	j. Certifications	k. Performance Curves	l. Design Data	m. Recommended Spare Parts List	n. Computations	o. Theory of Operation	p. Demolition	q. Material Safety Data Sheets	r. Other
01610	Mat'l Handling & Waste Disposal																	X	X
03200	Concrete Reinforcement	X																	
05400	Lightgage Framing		X			X													
05500	Structural & Miscellaneous Steel	X	X			X													
08100	Hollow Metal Doors & Frames	X	X	X	X														
08700	Hardware and Specialties		X	X	X														
09900	Painting				X	X		X		X									
15050	Equipment Installation	X				X	X	X		X									
15060	Piping and Appurtenances	X	X	X	X	X				X	X	X							
15099	Process Valves, Regulators, and Miscellaneous Components	X	X		X	X	X	X	X	X			X						
15140	Pumps	X	X		X	X	X	X	X		X	X	X	X					
15150	Neutralization and Chemical Storage Tanks	X			X					X		X		X					
15180	Pipe Insulation	X	X																
15221	Mechanical Mixer	X	X	X	X	X	X	X	X		X	X	X	X					
16150	Electrical Power Equipment	X	X	X	X	X	X	X	X	X	X	X	X	X					
16510	Lighting Fixtures			X															
16610	Cathodic Protection System	X	X	X	X	X	X	X		X		X	X	X					
16700	Heat Tracing	X	X			X	X					X		X					
16770	Life Safety Disaster Warning Systems	X	X	X						X									
17000	Gen'l Instrumentation, Control and Monitoring	X	X	X	X	X	X	X	X	X	X	X	X	X					
17300	Panels & Control Room Hardware	X	X	X	X	X				X									

SECTION 01500
TEMPORARY FACILITIES, CONTROLS,
AND SPECIAL PROJECT REQUIREMENTS

01501 FIRE PROTECTION SYSTEMS

The Contractor shall be responsible for fire protection for his own vehicles, facilities, and equipment.

01502 TEMPORARY FIELD OFFICE

The Contractor will not be required to furnish and maintain field office facilities for the Buyer; however, he shall provide for his own field office requirements if needed.

When a Contractor provides a temporary office or storage facility that is either a trailer or a portable building, a "Contractor Yard/Trailer Use Permit", see pages 01500-8 and 01500-9, must be completed and submitted to the Construction Management Inspection Manager for approval and issue.

A trailer or portable building will be located near the construction site at a location designated by the Buyer, and must be secured in accordance with the Standard for Trailer Anchorage on page 01500-5.

01503 GOVERNMENT-FURNISHED PROPERTY (Refer to GP-62)

- a. The Buyer will furnish to the Contractor, as free issue, the following property to be incorporated or installed in the work or used in its performance:

Item No.	Quantity	Description
D201, D202, D203, D204	4	Influent Storage Tanks
D205, D206, D207	3	Effluent Storage Tanks
Building 891	1	Erected Building
Treatment System	1	Ion Exchange/Degasifier
	1	UV/Peroxide Treatment System

- b. Such property will be furnished on or before initiation of construction.
- c. Such property will be furnished at Rocky Flats Plant.

01504 AVAILABILITY OF UTILITIES AND SERVICES (Refer to Special Provision No. 7 and GP-79)

- a. Potable water and electricity to complete construction of this contract work will be made available to the Contractor within 100 ft of the jobsite for work within existing building. For work conducted outside existing buildings, water and electricity will be made available at the nearest building or where designated by the Buyer.
- b. The Buyer and Construction Management Department will designate a parking area for the personal cars of the Contractor's employees. These cars must remain parked at the designated area throughout the working day. Only the Contractor's working vehicles will be permitted to be driven on the plantsite except before starting time and after quitting time.
- c. For interior work, Construction personnel can use toilet facilities adjacent to the work areas. for exterior work, the Contractor shall furnish toilet facilities for his personnel.
- d. All 120-V, single-phase, 15- and 20-A receptacle outlets, serving tools, or equipment being used outside of buildings shall be equipped with ground-fault circuit interrupters. Such interrupters shall be furnished by the Contractor. This requirement will be strictly enforced.

01505 TESTING (Refer to Special Provision No. 9)

- a. If it is provided in the technical sections that a test is to be performed at Buyer expense, costs of any such test which reveals that the contract requirements have not been met will be paid by the Contractor and not the Buyer.
- b. The Contractor shall cooperate with the Buyer and any testing organization selected by the Buyer in the preparation for the performance of any test to be conducted by the Buyer or any testing organization selected by the Buyer.
- c. Tests of Pressure Vessels
 1. Prior to installation and acceptance by the Buyer, any power boiler, low-pressure heating boiler, or unfired pressure vessel that is included within the scope of the ASME Boiler and Pressure Vessel Code, operated at pressures of 15 psi or greater, furnished under this contract, will be stamped with ASME Boiler and Pressure Vessel Code Symbol and a National Board of Boiler and Pressure Vessel Inspector's number, thus certifying that all necessary tests have been

performed. Manufacturer's data reports (unless exempted by the ASME Code) will be filed with the National Board in Columbus, Ohio.

Five copies of these data reports and National Board Certificate shall be submitted to the Buyer.

2. Any boilers or pressure vessels operated at pressure stated above, utilized by the Contractor in his performance of the work, will be similarly tested and certified before being brought on the project annually thereafter so long as they are used on the project site.
- d. If it is provided in the technical specifications that the Contractor is to perform field radiography of welds, the following shall apply:
 1. All field radiography shall be performed by a radiographer who is licensed by the Department of Health, State of Colorado.
 2. Prior to starting such work, the Contractor shall present to the Buyer for his approval written procedures regarding:
 - (a) The handling and use of the radioactive source on the plantsite and
 - (b) The operational methods to be followed in performing the field radiography.

01506 WORK PERMITS

Before the start of any excavation or welding, the Contractor shall request the appropriate work permit from the Buyer. Permits should be applied for well in advance of planned activities, to allow time for processing of permit applications. In addition, a Confined Entry Permit will be required for construction activities inside the effluent storage tanks. For excavations involving installation of buried utilities, including electrical and alarm systems, metallic-coated plastic detector tape will be issued as GFE to the Contractor to be installed approximately 12 in. directly above the buried utility or as directed by the Buyer.

01507 UTILITY OUTAGES

The Contractor shall furnish the Buyer 48 hr advance notice of any planned utility outage.

01508 LIGHTNING PROTECTION

New lightning protection systems shall be completed and in service (approved) prior to the time when the building or protected item is 85% complete as evidence by the Contractor's approved schedule and the Contractor's request for payment.

01500-4

R1-7-3

18 December, 1990

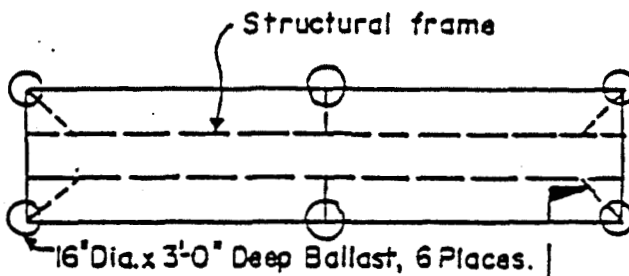
STANDARD FOR TRAILER ANCHORAGE

Trailers will have the following minimum anchorage measures taken to insure stability during high winds.

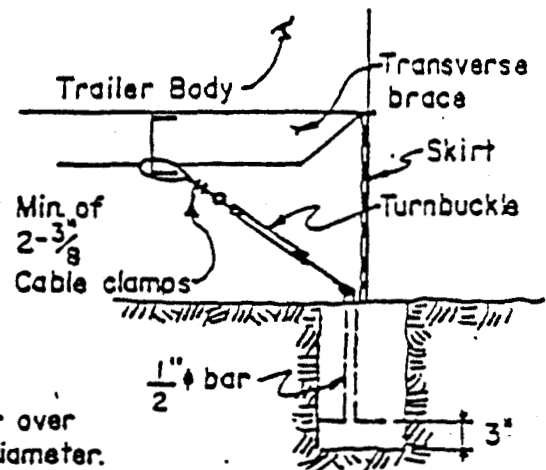
1. Long direction of trailer located in an east-west direction.
2. Located immediately east of an existing structure.
3. Base of trailer blocked up with 8"x8"x16" concrete blocks to the working elevation and tied down per sketch. Blocks will be placed at each tiedown point shown on the sketch.

"If for any reason measures 1 thru 3 cannot be followed, further analysis will be required by Engineering & Construction."

4. The Building Supt. will be responsible for inspection of Trailer blocking and tiedown integrity a minimum of twice a year, with assistance from Safety if required.
5. When the usual internal walls are going to be removed, in order to provide an open work space, a check with Engineering must be made to determine the need for additional internal bracing.



PLAN
NO SCALE



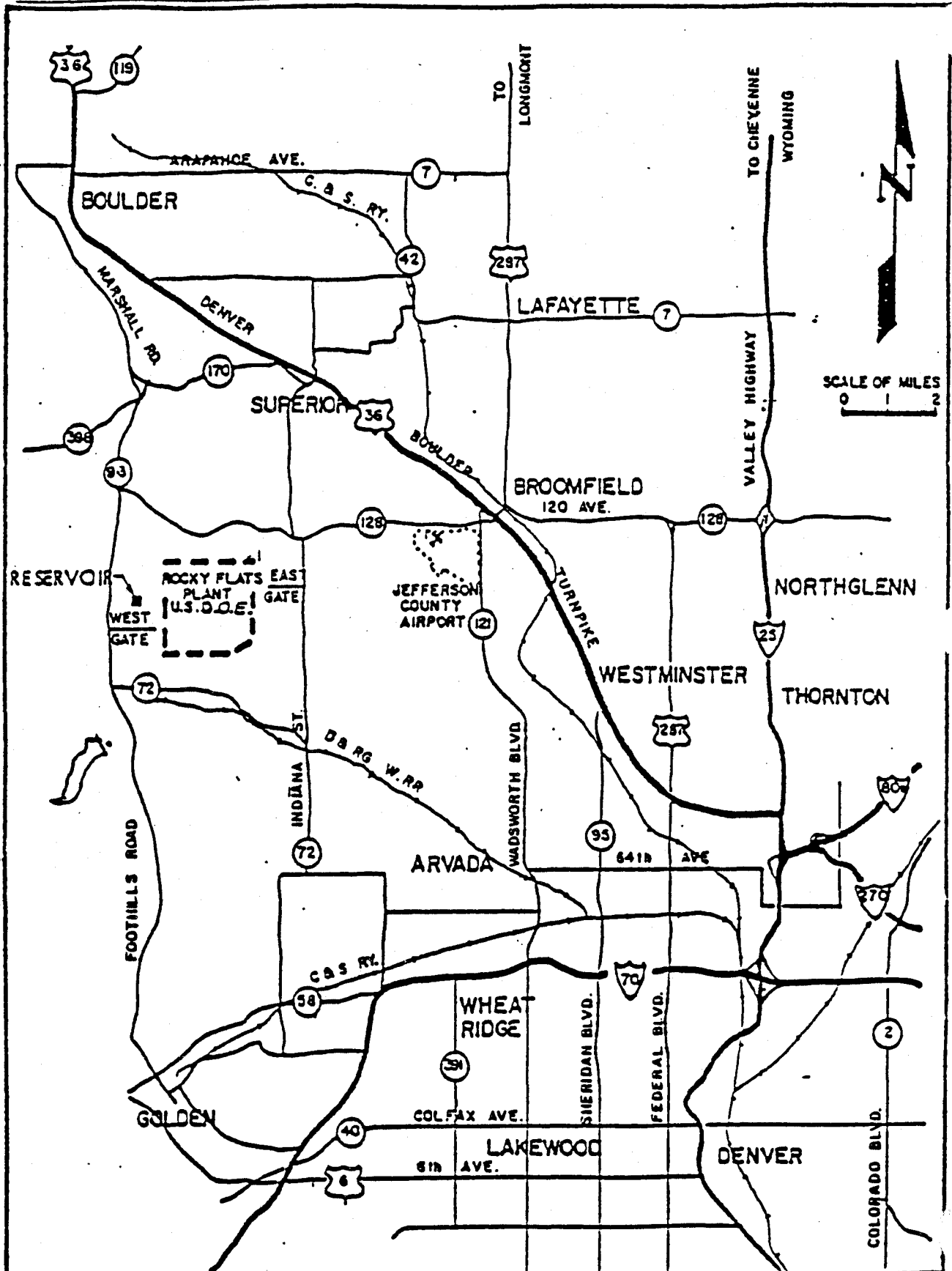
SECTION "A"
NO SCALE

- 1 Loop 3/8 Wire rope thru 1" holes in frame or over frame then loop thru turnbuckle of same diameter.
- 2 Turnbuckle fastened to 1/2" Anchor embedded in 16" dia. x 3'-0" deep concrete ballast 6 places.
- 3 Locate all holes and or loops within 4" of transverse member.

ROCKY FLATS PLANT STD

A	ORIGINAL ISSUE	6216	2-20-79	WGL	1/1
Issue	Description	App'd.	Date	By	App'd.
SAFETY		Design Engr. Dept.			
STANDARD FOR: TRAILER ANCHORAGE		Rocky Flats Plant GOLDEN, COLORADO			
SIZE	DRAWING NUMBER	ISSUE	SHEET		
STANDARD NO. SC 103	A 23854-1	A	1 of 1		

ROCKY FLATS PLANT LOCATION MAP

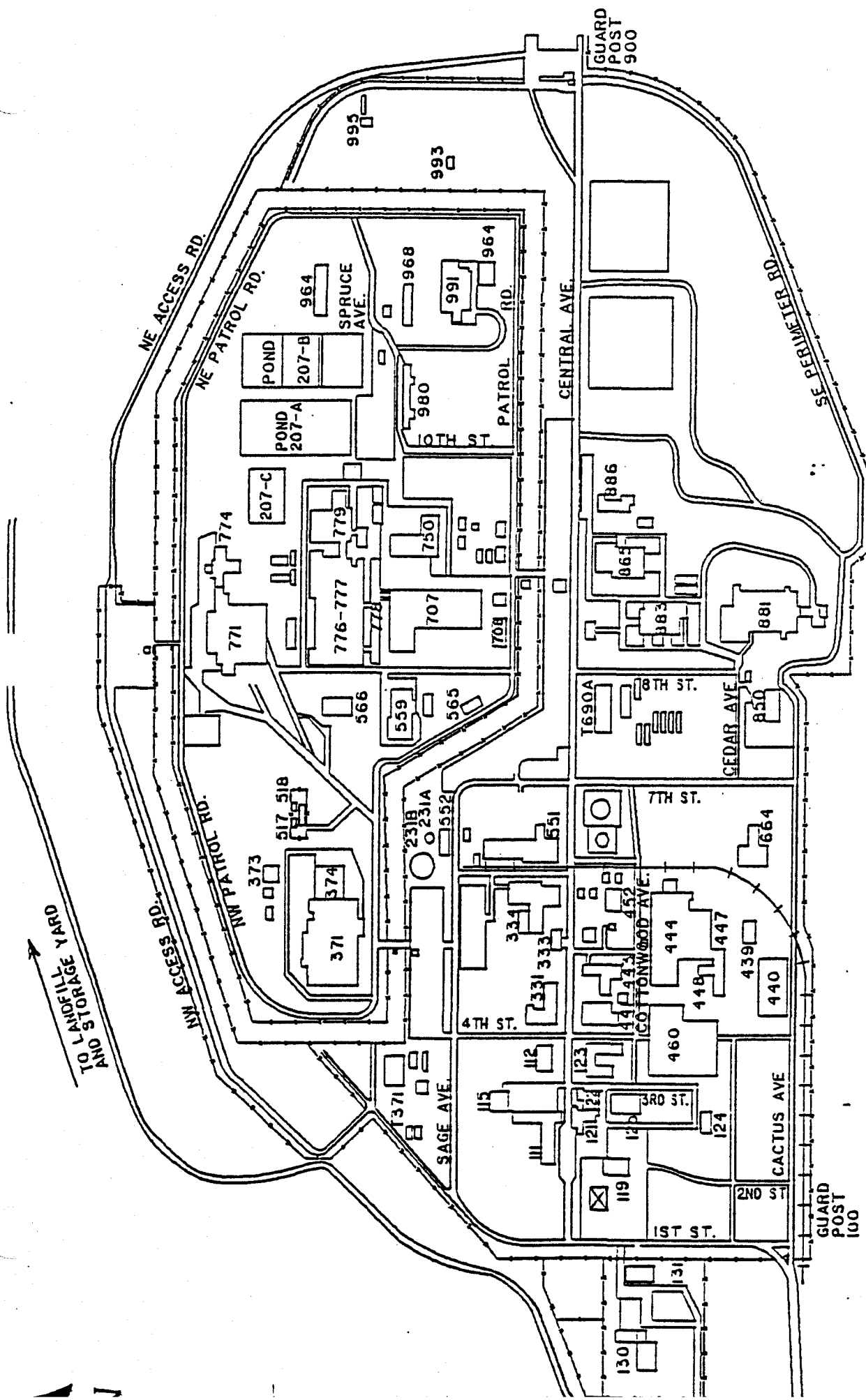


DATE - 1/28/81

ROCKY FLATS PLANT

SCALE - GRAPHIC

LOCATION MAP



ROCKY FLATS AREA PLOT PLAN

R.W.S.C.B.L.L.R.F.AREA PLOT PLAN 5/89

ROCKY FLATS AREA PLOT PLAN

ROCKY FLATS
CONTRACTOR YARD/TRAILER USE PERMIT

DATE: ___/___/___ (SEE BELOW)

CONTRACTOR: _____ SUPERVISOR: _____

ADDRESS: _____ PHONE: _____

PROJECT: _____ AREA/BLDG: _____

CONTRACT NO.: _____ AUTHORIZATION NO.: _____

CONTRACT PERIOD: (FROM) _____ (TO) _____

TRAILER USED FOR: _____

TYPE OF MATERIAL STORED: _____

FLAMMABLES (?): _____

CONTRACTORS MUST COMPLY WITH ALL RULES PERTAINING TO THE USE OF THE CONTRACTOR'S OFFICE/STORAGE FACILITIES AT ROCKY FLATS. CONSTRUCTION MANAGEMENT PERSONNEL WILL CONDUCT WEEKLY INSPECTIONS OF THE AREA TO INSURE CONTRACTOR COMPLIANCE. VIOLATIONS OF THE RULES CAN RESULT IN EVICTION.

EG&G MAY DISPOSE OF ANY CONTRACTOR EQUIPMENT/MATERIALS REMAINING ON PLANT- SITE MORE THAN TEN DAYS AFTER COMPLETION OF THE CONTRACT.

THIS PERMIT IS VALID FOR THE DURATION OF THE CONTRACT - NOT TO EXCEED ONE YEAR. REISSUANCE OF THE PERMIT IS THE RESPONSIBILITY OF THE CONTRACTOR.

CONTRACTOR REPRESENTATIVE

CONSTRUCTION COORDINATOR

FIRE DEPARTMENT

CONSTRUCTION MANAGEMENT MANAGER

HS&E

(Permit must be enclosed in a waterproof plastic envelope, and securely attached to the outside entrance to the trailer. A separate permit is required for each trailer.)

ROCKY FLATS AREA PLOT PLAN

RULES PERTAINING TO CONTRACTOR'S YARD

1. PERMIT MUST BE DISPLAYED ON OUTSIDE OF TRAILER
2. TRAILER MUST BE TIED DOWN ACCORDING TO EG&G Rocky Flats STANDARD
3. ONLY EG&G Rocky Flats MATERIALS CAN BE STORED
4. TRAILER TIE-DOWNS MUST BE CLOSE TO THE GROUND - NO DIRT OR CONCRETE PILES
5. FUEL STORAGE TANKS MUST BE KEPT SAFE AND APPROVED BY FIRE DEPARTMENT
6. STAIRS MUST BE KEPT SAFE AND TIED DOWN
7. NO HAZARDOUS MATERIALS (OTHER THAN FUEL) ARE TO BE STORED/USED/DISPOSED OF
8. DAMAGED ROADWAYS ARE TO BE REPAIRED
9. PALLETS, EMPTY BOXES, ETC. MUST BE DISPOSED OF
10. NO MATERIALS ARE TO BE STORED DIRECTLY ON THE GROUND
11. ALL MATERIALS ARE TO BE STACKED NEATLY AND TIED DOWN IF SUSCEPTIBLE TO WIND
12. TARPS ARE NOT ACCEPTABLE DURING HIGH WIND PERIODS
13. LONG TERM USE MATERIALS MUST BE WAREHOUSED OR STORED IN A TRAILER
14. NO LOOSE PLASTIC, SHEET METAL, PLYWOOD, ETC. IS ALLOWED
15. ON COMPLETION OF THE CONTRACT, REMOVE CONCRETE BLOCKING, WIRES, CABLES, ETC.
16. THE GENERAL APPEARANCE OF THE AREA AT ALL TIMES MUST BE GOOD.

SECTION 01610
MATERIAL HANDLING AND WASTE DISPOSAL

01611 WASTE DEFINITIONS

Construction projects deal with five types of waste as defined below:

- a. Off-Site Sanitary Waste -- Routine, non-radioactive, non-hazardous waste acceptable to public landfills. Such wastes include paper, waste cardboard, plastic, metal, wood, glass, garbage (food waste), sand, gravel, concrete, masonry products, and miscellaneous construction debris. Waste materials noted in this paragraph and generated from the buildings identified in the Approved Building List at the end of this Section, shall be considered Off-site Sanitary Waste.
- b. On-site Sanitary Waste -- Waste materials described as in paragraph (1.) above, except coming from buildings and areas of the plant not identified in the Approved Building List. Excess excavated materials, asphalt street paving, and waste generated from the exterior of all buildings (even those on the Approved Building List) shall be handled as on-site sanitary waste. Asbestos disposal must be handled as detailed in other sections of the Technical Provisions.
- c. Hazardous Waste -- Those waste materials exhibiting a hazardous characteristic (ignitable, corrosivity, reactivity, or toxicity) or are listed in Colorado Hazardous Waste Regulations 5-CCR-1007-3. Examples of hazardous wastes include paint thinners, Freon, Trichloroethene, epoxy and enamel paints.
- d. Contaminated Waste -- Those waste materials that contain or are contaminated with radioactive materials.
- e. Mixed Waste -- Those waste materials containing both hazardous and contaminated materials.
- f. Empty Containers -- Those containers that have met the conditions set forth in 6-CCR-1007-3, 261-7, Colorado Hazardous Waste Regulations, and are therefore not considered hazardous wastes even though they may have contained hazardous or toxic materials at one time. Empty containers shall only be disposed at the Rocky Flats on-site landfill.

01612 GENERAL REQUIREMENTS

- a. The Contractor shall closely adhere to the following procedures to assure that all waste generated during construction will be properly dispositioned and disposed.
- b. A preconstruction conference will be held with the Contractor immediately after award of the contract. In addition to the standard review of procedural items including the Health and Safety Plan, waste handling procedures will be reviewed with the Contractor.
- c. Submittals -- The Contractor will be required to submit a Waste Handling Plan for approval by the Buyer before starting construction. This plan will identify the types, location and approximate volume of the different kinds of waste that will be generated, on-site storage locations, permanent disposal sites to be used, and a listing of subcontractors/vendors who will haul or dispose of waste materials. Contractor will submit Material Safety Data Sheets for all materials used and disposed.
- d. The Contractor shall use returnable containers and packages for all materials and supplies delivered to the jobsite whenever possible. The Contractor shall limit, as much as possible, the amount of waste accumulated during construction.
- e. All material and equipment being removed from buildings or exterior sites, except those identified in the Approved Building List at the end of this Section, shall be monitored by Radiation Monitoring before being removed from the area.
- f. The Contractor shall, at all times, keep the work area clean and orderly. All debris, scrap, and rubble shall be removed from the work area as they are created. At the end of each work shift, the work area shall be swept clean and left in a neat and orderly manner. Access routes for other personnel must be kept clear at all times.
- g. Installed equipment and materials removed by the Contractor under this contract, and not authorized to be reused in the work, shall remain the property of the Buyer. All such equipment and material shall be properly identified and delivered to the Buyer as directed by the Buyer. The Contractor shall use care in removing salvageable materials and equipment so as not to cause undue damage that may render the equipment or materials unusable.

01613 WASTE DISPOSAL SITES

- a. Waste disposal is approved for several locations, depending on the nature and type of the waste materials. These sites are:
1. BFI Waste Systems Landfill -- This site is located three miles south of plant site on Highway 93. All materials approved as Off-site Sanitary Waste shall be transported and dumped at this landfill. The Contractor shall provide for all transportation; however, all dumping fees will be paid by the Buyer under an existing landfill contract with EG&G Rocky Flats. Dumping fees shall not be included or reimbursed as part of the construction contract proposal.
 2. Rocky Flats On-site Landfill -- This site is located one mile north of Guard Post 100. The Contractor shall provide for all transportation to this site. No fees are required. Waste materials approved for this site include waste that comes from buildings or areas that are not included on the Approved Building List, but have been monitored by Radiation Monitoring as being non-contaminated, including:
 - Excess excavated material.
 - Asbestos (see technical sections 02080 if applicable).
 - Removed roofing materials containing or mixed with asbestos.
 - Broken asphalt.
 - Empty containers.
- b. The Rocky Flats On-site Landfill will be open Monday through Friday from 7:45 a.m. to 11 a.m. and 12:30 p.m. to 2 p.m. Clean dirt and broken asphalt may be dumped until 3:30 p.m.
- c. Other dumping areas for waste materials may not be used unless written permission is obtained from the Buyer for disposal at other sites.
- d. Concrete truck washout will be permitted at the Rocky Flats Landfill as noted on the Area Plot Plan, in a location designated by the Buyer.

01614 SANITARY WASTE DISPOSAL FROM APPROVED BUILDINGS

This subsection identifies the handling of construction rubble and waste that are considered suitable for disposal at the BFI Waste Systems Landfill. Only waste generated from buildings identified in the Approved Building List at the end of this section shall be considered as Off-site Sanitary Waste.

- a. The Construction Coordinator will maintain a separate log for each project that identifies each load transported. When a load is ready for offsite transport to the BFI Waste Systems Landfill, the Construction Coordinator will take a sequentially numbered copy of the Master Return Order to the Traffic Department who will then prepare a Bill of Lading authorizing shipment. The Contractor shall allow one hour after the waste is loaded in the transport vehicle for the preparation of documentation authorizing off-site shipment of sanitary waste.
- b. The Contractor will take the Bill of lading to the Shipping Department in Building 130. The Contractor will sign the Bill of Lading at the time and will retain the Security copy.
- c. Plant Security personnel will stop each transport vehicle, as it exits Guard Post 8, and will retain the Security copy of the Bill of Lading for each load before allowing the vehicle to continue on to the BFI Waste Landfill.
- d. Off-site Sanitary Waste does not require monitoring by Radiation Monitoring. All other types of waste must be monitored.
- e. All waste material delivered to the Contracted Off-site Sanitary Landfill will be disposed in accordance with the terms of that contract.
- f. All loads taken off-site must be fully secured and covered. Any additional dumping fees resulting from improper loading and handling shall be paid for by the Contractor.
- g. All waste dumpsters furnished by the Contractor shall be locked at all times when not in use. The Contractor shall designate a custodian for each dumpster who is responsible for the collection, control and surveillance of waste deposited in the dumpster.

01615 WASTE SEGREGATION, CONTROLLED RELEASE AREAS

All areas of the plant, other than those identified in the Approved Building List, have the potential to contain multiple types of waste, including on-site sanitary and contaminated waste.

This subsection deals with the segregation and disposal of waste from these areas.

The following steps govern the disposition, segregation and disposal of waste as it is generated:

- a. The Construction Coordinator will arrange for a site survey by Radiation Monitoring before any demolition or excavation activities begin. This survey will identify potential waste types and identify construction procedures required for other than sanitary type waste.
- b. The Construction Coordinator will monitor the Contractor's compliance with his approved plan as well as compliance with all applicable Rocky Flats waste procedures. The Construction Coordinator will assist the Contractor in the identification of waste types, in particular contaminated versus on-site sanitary waste. Any radiation Monitoring support or other EG&G involvement will be requested and coordinated by the Construction Coordinator.
- c. All waste will be segregated and monitored by Radiation Monitoring as it is generated and before loading for transport to a permanent disposal site. The Construction Coordinator will arrange for final monitoring by Radiation Monitoring of each loaded transport vehicle.
- d. On-site sanitary waste shall be hauled to the Rocky Flats On-site Landfill.
- e. The site survey conducted by Radiation Monitoring will identify low level radioactive and contaminated waste. The Construction Coordinator will also provide direction for the segregation of hazardous wastes. If improper segregation does occur, or mixing of waste types is identified, segregation of on-site sanitary waste will be attempted. If this is not possible, the identified waste load will be handled as the appropriate waste type. Under no circumstances will contaminated or hazardous waste be shipped off-site as sanitary waste.
- f. Contaminated waste shall be deposited in waste boxes provided by the Buyer. Disposal of such boxes shall be the responsibility of the Buyer.

01617 HANDLING AND DISPOSAL OF HAZARDOUS WASTE

- a. Before bringing a hazardous material to Rocky Flats, a Contractor must notify Industrial Hygiene and Hazardous Material Control through the Construction Coordinator. If a Material Safety Data Sheet (MSDS) for the material is not in Hazardous Materials Control's master file, the Contractor must provide a copy thereof.

- b. The use of the chlorinated solvents 1.1.1 - Trichloroethane (TRIC or Chloroethene VG) and Freon-TF (Genesolv) as cleaners and degreasers has been discontinued at Rocky Flats as of October 1, 1988. There are nonhazardous substitutes available including Alum Oakite NST Cleaner (as a 5% solution in water) and "De-Solv-it". Contact the Rocky Flats Construction Coordinator for the use and disposal of these substitutes or other substitute cleaners and degreasers proposed by the Contractor.

APPROVED BUILDING LIST
(Revision 2)

331A	020	443
	060	549
T112A	061	551
T121A		
T334B	100	552
T371A	111	553
T371C	112	554
T371D	113	555
T371F	114	556
T371G	115	558
T441A	119	661
T442A	120	662
T452A	121	
T452B	124	675
T452C	127	900
T452D	128	920
T452E	129	931
T452G	130	987
T690A	131	988
T690B	250	993
T690C	333	995
T690D	335	
T690E	428	
T690F	429	
T690G		
T690H		
T690M		

SECTION 1700

CONTRACTOR SAFETY REQUIREMENTS

01701 APPLICATION OF REQUIREMENTS

These safety requirements apply to all contractors performing work under direct contract or subcontract at the Rocky Flats Plant. Contractors shall be responsible for compliance by their subcontractors with the safety requirements of this contract.

01702 CODES AND REGULATIONS

~~The contractor shall take all reasonable precautions in the performance of the work to protect the safety and health of employees and others and to protect property.~~ Contractors shall comply with applicable Federal, State, and local codes and regulations for safety and health, including, but not limited to:

- a. Contract Work Hours and Safety Standards Act of 1969 and subsequent amendments.
 1. Occupational Safety and Health Administration (OSHA) 29 CFR 1926 - Safety and Health Regulations for Construction
- b. Public Law 91-596, Occupational Safety and Health Act of 1970 and subsequent Amendments.
 1. Occupational Safety and Health Administration (OSHA) 29 CFR 1910 - Safety and Health Regulations for General Industry
 2. Occupational Safety and Health Administration (OSHA) 29 CFR 1904 - Recording and Reporting Occupational Injuries and Illnesses
- c. American National Standards Institute (ANSI) Standards as referenced in OSHA 29 CFR 1926 and 29 CFR 1910
- d. National Fire Protection Association (NFPA) Codes as referenced in OSHA 29 CFR 1926 and 29 CFR 1910
- e. Mine Safety and Health Administration (MSHA) 30 CFR 56 (for any quarrying or crushing activities)
- f. The contractor shall be responsible for complying with new or modified industry codes and regulations that apply to this project/contract, as they are promulgated during the term of this contract. Actual expenses incurred as a result of compliance with new or modified codes or regulations will be reimbursed to the contractor.

01703 DESIGNATED SAFETY PERSON

The contractor shall employ at least one person on site having overall safety responsibility and having the authority to perform required safety related duties. This individual may also function as the project superintendent with the approval of EG&G. The designated safety person will be required to attend additional EG&G safety training for this project. The contractor should budget eight (8) hours for this training.

01704 CONTRACTOR'S SAFETY PROGRAM REQUIREMENTS

- a. Within 10 working days after award of this contract and before commencing work on the project, the contractor shall submit, to EG&G Construction Management, a copy of the contractor's written health and safety program. The program will be reviewed and approved by EG&G Construction Safety, prior to any contractor on-site activity. The contractor's safety program shall include, as a minimum:
 1. Specific procedures, requirements, equipment, and facilities to (1) eliminate hazards, (2) reduce hazards to a minimum, or (3) guard against hazards associated with this project.
 2. Provisions for daily project safety inspections to be completed by the designated safety person with hazards found and corrective actions taken recorded in a permanent log. The daily safety inspection log shall be signed by the designated site safety representative. The daily safety log shall be submitted to EG&G upon project completion.
 3. Provisions for removing from service any equipment which is found to be in a hazardous condition.
 4. Provisions for the immediate reporting of all injury, illness and property damage incidents occurring at the Rocky Flats Plant to the EG&G Construction Coordinator.
 5. Provision for the completion of comprehensive incident investigations and report. All incident investigation reports shall be submitted to EG&G Construction Management for review by EG&G Construction Safety within 24 hours of the incident. Reporting to EG&G shall be made on EG&G forms available from the EG&G project Construction Coordinator and provided at the pre-construction meeting.

The contractor shall cooperate completely in all Critique Meetings initiated by EG&G to evaluate incidents.

6. Provisions for the submitting of two (2) copies of the OSHA 200 Log on a monthly basis, and two (2) copies of OSHA 200 Summary, at project completion, to the EG&G Construction Coordinator.
7. Procedures for the immediate and subsequent treatment of injured workers. Any contractor employee experiencing any injury or illness on the project shall report as soon as possible to EG&G Medical Department for evaluation. EG&G Construction Management shall be notified whenever an employee reports to medical.
8. Provisions for the training, either site specific or otherwise required, of all contractor employees and associated personnel in the recognition of project hazards. The amount of time to be allotted for the training of contractor and subcontractor personnel, exclusive of job task training, for this project shall be four (4) hours per craft employee and eight (8) hours per supervisory employee.
9. Provisions for the utilization of only those persons adequately trained and competent to operate assigned equipment or perform assigned tasks. Job task training, conducted by the contractor, shall be a part of routine job assignments. Training shall include the recognition of the hazards associated with the operation of assigned equipment or performance of job tasks.
10. Provisions for safety and health meetings ("tool box" meetings) conducted on a weekly basis for all contractor employees. Each meeting shall be approximately one hour in length, occur during working hours, and be specific to the project and shall include, at a minimum, discussions of recent inspection findings and corrective actions, incidents, and upcoming safety requirements. The Construction Coordinator shall be notified 24 hours prior to the safety meeting. Upon completion of the meetings, copies of reports and minutes shall be furnished to the EG&G Construction Coordinator within 24 hours.
11. Provisions for project site posting of EG&G Construction Safety inspection reports.
12. Provisions for five (5) working days advanced notification to the EG&G Construction Coordinator of

when equipment will be brought on site and of special activities, i.e., critical lifts, road closures, confined space entry, hot work welding permits, any power interruptions or outages, etc.

Moving equipment from one project site to another will require the five (5) day advance notice, but flexibility will be extended if equipment is currently approved to be used on plant site. EG&G Construction Management must be notified prior to any equipment move.

13. Provisions for the control of repeat safety violations and violators.
 14. Procedures for excellent housekeeping including immediate disposal of all trash and construction refuse. This shall be performed continuously with end-of-day clean-up. A final clean-up shall be completed at the end of the project and prior to the contractor leaving the site.
- b. The contractor shall communicate to its employees their safety rights (a work place free of recognized hazards with a procedure to make hazards known to management) and their safety responsibilities (to work in a safe manner). A DOE poster and complaint form, provided by EG&G, is required at all construction sites and construction offices.
 - c. Contractors, key subcontractors, and their safety personnel shall attend a pre-construction safety meeting and general safety orientation conducted by EG&G. A walk-through inspection for site layout, plans, housekeeping, signs, traffic control, project access control, etc. will be conducted prior to construction start.
 - d. It is the responsibility of the contractor to orient all employees and subcontractors and their employees, to site safety working conditions and requirements.
 - e. EG&G will perform random safety checks/inspections of the work site and construction equipment and examine such documents as it may request from the contractor in connection with such safety checks/inspections. The contractor shall cooperate in such checks and inspections.
 - f. The contractor shall complete all required corrective actions of identified hazards within the designated time frame. The contractor's failure to comply with the issued corrective notices may result in (1), a second notice of noncompliance or (2) a stop work order for all, or part of, the project. If the contractor again fails to complete the agreed on corrective action within the allotted time frame,

necessary corrective work may be instituted by EG&G and unilaterally charge the contractor for all costs thereof. Such charges will be deducted from payments otherwise due the contractor.

- g. EG&G Construction Management may request the contractor to remove from the work site any employee deemed objectionable. The contractor shall remove, or have removed, from the site:
 - 1. Employees whose actions or activities, either singularly or combined, create an unacceptable hazard to themselves, others, property, or who refuse to comply with the safety requirements of this contract.
 - 2. Contractors or subcontractor's supervisors who are unable or unwilling to manage personnel performance in compliance with the safety requirements of this contract.

01705 STOP WORK ORDERS

- a. The contractor shall comply immediately with any stop work orders issued by EG&G through the Construction Coordinator. The contractor shall convey to its supervisors and workers EG&G's authority to stop all work when there is an imminent danger to worker's health and safety, imminent danger of property loss, failure to correct a hazardous condition or action in the allotted time frame and instances of repeat safety violations.
- b. Work may resume only when the condition or action has been corrected to the satisfaction of EG&G. Written release to resume work will be provided by EG&G Construction Management with concurrence of EG&G Construction Safety.
- c. The contractor shall not be entitled to claims for damages for losses incurred, or for an extension of time, as a result of the issuance of stop work orders due to contractor controlled hazardous conditions or actions or for compliance with safety requirements of this contract.

01706 JOB SAFETY ANALYSIS

- a. Those contractor shall submit an overall project schedule identifying those events with critical safety impact or requirements or with a high potential hazard to personnel or property. Critical items require a Job Safety Analysis (JSA), which shall be reviewed and approved by EG&G Construction Safety prior to work starting on that critical activity. OSHA publication, "OSHA 3071, JOB HAZARD ANALYSIS", should be used as a guide in preparation of the JSA and is available from EG&G Construction Management.

- b. A JSA is the breaking down into component parts of any method or procedure and shall include:
 - 1. A determination of the hazards connected therewith and associated with each step or task.
 - 2. A determination of the requirements or qualifications of those who are to perform each step of the work.
 - 3. Directions for implementing solutions to eliminate, nullify, or reduce to a minimum the consequences of such hazards.

01707 SITE SPECIFIC SAFETY REQUIREMENTS

EG&G "Site specific" construction safety requirements are those employing Rocky Flats Plant adopted policies, operating directives, plant standards, and codes applicable to this construction project. These requirements include the following and apply to all construction performed at Rocky Flats:

- a. All workmen will be required to wear hard hats. All visitors to posted construction areas will be required to wear hard hats.
- b. All compaction performed with vibratory equipment will be performed by workmen wearing approved foot protection devices.
- c. All contractor personnel will wear shirts that cover the shoulders, long pants, and work shoes on the plant-site. Special protective equipment required to perform specific tasks will be worn when specified and in the proper manner.
- d. Ladders
 - 1. Three-legged ladders are not allowed.
 - 2. Aluminum ladders are not allowed for work in areas where there is electrical power equipment.
 - 3. Industrial fiberglass ladders are allowed for all applications.
 - 4. Wooden ladders are not allowed in radiological areas.
- e. A lift device known as the "Xtraman Hoist", or any lifting devices where, by design, the operator or any other person is used as the ballast or counterweight of the device is not to be used on construction projects.

- f. Safety eye-wear with side shields will be worn at all times. Exceptions are when a passenger in a vehicle with no hazardous exposures, or in an office.
- g. Limitations are placed on work activities due to wind speed and weather conditions as determined by the EG&G Construction Coordinator.
- h. Prior to brining ANY chemical on plant site, contact Industrial Hygiene, 966-2780, for compliance directions in RFP Hazardous Communication Program. Contractor will supply MSDSs for all materials used and/or disposed.
- i. Medical certifications required for this project will be determined by the Site Specific Safety and Health Program developed for this project. Contractor employees required to have medical certifications shall have the necessary medical examinations completed off-site and at the contractor's expense.
- j. Operation Health Physics requirements have been determined by the Site Safety and Health Program developed by the Buyer for this project.
- k. Submit a written Site Specific Health and Safety Plan prepared and signed by a Certified Industrial Hygienist, indicating the procedures to be used by the contractor to comply with the Rocky Flats Plant Environmental Restoration Site Specific Health and Safety Program Plan. The Site Specific Health and Safety Plan must be approved by the Buyer prior to start of work.

01708 INITIATION OF WORK

- a. All contractor supplied equipment and tools shall be inspected by EG&G Construction prior to use on site. Contractor shall be required to immediately shut down, repair, or remove from the Rocky Flats Plant any equipment not meeting safety codes.
- b. Any equipment that has been modified in any way after being brought on site, and receiving the initial inspection, shall be reinspected by EG&G Construction Safety.
- c. All construction work requires an EG&G Work Permit, which must be obtained through the EG&G Construction Coordinator and approved by EG&G Construction departments prior to start of any work activities. Additional permits are required for specific activities. All permits will be prepared and obtained by EG&G.
- d. The contractor shall immediately notify EG&G Construction Management of any safety related changes to the project.

- e. Routine safety meetings involving all contractors performing work at the Rocky Flats Plant will be held to discuss mutual problems, findings, trends, etc. EG&G Construction Management will notify contractors of such meetings. Contractor shall attend regular and other construction safety meetings held by EG&G. The site-specific Health and Safety Plan will be reviewed with Contractors in preconstruction meetings.

01709 CRITICAL 29 CFR 1926 STANDARDS FOR Remedial Action, 881 Hillside

The successful contractor will be required to follow all federal, state, and local safety requirements, as well as Rocky Flats plant requirements. ~~The Contractor is solely responsible for the protection of its employees.~~ Methods of compliance with safety requirements are defined in the site-specific Health and Safety Plan. The Health and Safety Plan will be prepared by a Certified Industrial Hygienist.

The following is a description of codes for work on Remedial Action 881 Hillside. This work will be subject to both 29 CFR 1910 and 29 CFR 1926. In particular, the contractor should pay close attention to the following standards. All parts of 29 CFR 1910 and 29 CFR 1926 will be enforced, but the following standards are of special importance to the stated description of work.

29 CFR 1910.134	Requirements for a Minimal Acceptable Program
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1910.20	Access to Employee Exposure and Medical Records
29 CFR 1926.103	Respiratory Protection
29 CFR 1926 Subpart "L"	Ladders & Scaffolds
29 CFR 1926.100-104	Personal Protective Equipment
29 CFR 1926.251	Rigging Equipment and Material Handling
29 CFR 1926. Subpart "J"	Welding and Cutting
29 CFR 1926.550	Cranes and Derricks
29 CFR 1926.552	Material and Personnel Hoists
29 CFR 1926 Subpart "R"	Steel Erection

Though special attention must be given to the above standards, that does not relieve the contractor of his responsibility to follow all requirements of 29 CFR 1926 or RFP site safety requirements.

The successful contractor's safety and health plan shall describe how the contractor plans to comply with the indicated 29 CFR 1926 regulations.

01710 POST-CONSTRUCTION ACTIVITIES

The contractor shall submit a final report to EG&G Construction Safety detailing their safety performance during the project. This report shall be submitted within 10 working days after EG&G accepts the project.

SECTION 02200

EARTHWORK

PART I: GENERAL

1.1 APPROVAL: Prior to starting any excavations, an approved excavation permit and written permission shall be obtained from the Buyer.

1.2 PROTECTION AND SAFETY

A. Traffic Control

1. Keep all roads, sidewalks, and parking areas that are not part of this project usable at all times.
2. The Buyer shall provide all necessary barricades, lights, signals, etc., for the protection of the workers and the public, as established by the Occupational Health and Safety Administration (OSHA) Construction Safety and Health Regulation 29 CFR, Part 1926, Subpart G, Signs, Signals, and Barricades.
3. All non-essential vehicles are prohibited from the construction site.

B. Excavations, Trenching, and Shoring

1. All excavations, trenching and shoring shall comply with the rules and regulations as established by OSHA Construction Safety and Health Regulations 29 CFR, Part 1926, Subpart P, Excavation, Trenching, and Shoring.
2. OSHA Pamphlet 2226, Excavation and Trenching Operations, can be used as an additional aid.
3. All construction activities shall be performed so as to minimize the generation of fugitive dust. Soils shall be wetted to control dust during excavation work, on access roads and in high traffic areas.

1.3 EXISTING UTILITIES

- A. Notify the Buyer immediately when existing utilities are encountered during excavation.
- B. Obtain approval from the Buyer before backfilling existing utilities.

PART II: PRODUCTS

2.1 EXCAVATED MATERIAL

- A. Material to be excavated is assumed to be earth and other materials that can be removed with a power shovel.
- B. If rock is encountered within the limits of excavation, notify the Buyer immediately and do not proceed except as instructed.
- C. Contaminated soil, if encountered, shall be stockpiled separately from clean soil. Contaminated soil shall not be used as fill.

2.2 FILL MATERIALS

- A. Fill material for structures and utility trenches shall be granular soils free of organic matter.
- B. Sand fill shall pass a 20-mesh and be retained on a 200-mesh U.S. Standard sieve and shall be free of organic material, trash, and debris.
- C. Frozen materials shall not be used for fill.
- D. All suitable material removed from the excavation shall be used in forming fills. No excavated material shall be wasted without approval of the Buyer.
- E. Fill for storage areas and roads shall consist of overburden and bedrock materials, including broken asphalt pavement, obtained from excavated areas.
- F. Water, Gas, and Underground Conduit Embedment Material. This material shall be sand fill.
- G. Frozen materials shall not be used for fill.
- H. All suitable material removed from the excavation shall be used in forming fills. No excavated material shall be wasted without approval of the Buyer.
- I. Fill for storage areas and roads shall consist of overburden and bedrock materials, including broken asphalt pavement, obtained from excavated areas.

2.3 WARNING TAPE

Furnished by Buyer and installed by Contractor.

PART III: EXCAVATION

3.1 GENERAL

- A. The worksite and areas shown on the drawings shall be cleared of all natural obstructions and existing foundations, pavements, utility lines, and other items that will interfere with the construction operations, as approved by the Buyer.
- B. Proper allowances shall be made for form construction, waterproofing, shoring, and inspection. Where walls or footings are authorized to be deposited directly against excavated surfaces, the surfaces shall be sharp, clean, and true. Bottoms of excavations for footings, piers, grade beams, etc., shall be level, clean, and clear of loose materials.
- C. Trenching for utility systems shall be of sufficient width for proper laying of pipe and conduit. The trench banks shall be as nearly vertical as is practical. Undercutting will not be permitted. Trenches shall be of sufficient depth to provide not less than the minimum cover shown on the drawings or 3 ft.
- D. Protect bottoms of all excavations from free-standing water and frost. Do not place foundations, footings, grade beams, or slabs on wet or frozen ground.
- E. Suitable excavated material that is required for fill under slabs shall be separately stockpiled as directed by the Buyer.

3.2 OVEREXCAVATION

- A. All unstable materials encountered below the established elevation of the excavation that will not provide a firm foundation for subsequent work shall be removed as directed.
- B. Where the excavation is directed to be made below the established elevations, the excavation, if under slabs, shall be restored to the proper elevation in accordance with the procedure specified for backfilling, or if under footings, the depth of the walls or footing shall be increased as may be directed by the Buyer.
- C. Excavations carried below the depth indicated WITHOUT SPECIFIC DIRECTION shall be returned to the proper elevation in accordance with the procedure specified for backfilling, except that in wall or footing excavations, the concrete shall be extended to the bottom of the excavation.

3.3 BACKFILLING

- A. Prior to backfilling, remove all forms and clean excavations of all trash and debris.
- B. Trenches for piping, conduits, or other underground utilities shall be backfilled to a minimum of 6 in. over the top of the pipe, conduit, cable, etc., with sand fill unless otherwise detailed on the drawings.
- C. Fill shall be placed in horizontal layers not in excess of 6 in. in thickness and shall have a moisture content such that the required degree of compaction may be obtained. Each layer shall be compacted by hand or machine tampers or by other suitable equipment to 90% of maximum density as determined by the Modified Proctor Testing Method.
- D. Install Buyer-furnished orange warning tape 12 in. above any underground utilities.
- E. Spreading Fill Material
 - 1. Completed fill shall correspond to the contours shown on the drawings.
 - 2. Place fill materials in successive layers of loose materials not more than 6 in. deep.
 - 3. Uniformly spread each layer using a road machine or other approved device.
 - 4. Compact each layer of fill thoroughly using an approved roller to obtain 90% maximum density, as determined by the Modified Proctor Testing Method, ASTM D 1557.

3.4 SUBGRADE PREPARATION

Subgrades not requiring fill shall be prepared as follows:

- A. Subgrade Preparation
 - 1. Rough grade the surface to the approximate final shape of subgrade required.
 - 2. Scarify the surfaces to a maximum depth of 6 in., and thoroughly cultivate until the material is finely divided.
 - 3. Alternately water and recultivate the subgrade material to obtain the optimum moisture content required for compaction. Minimum depth of moistened subgrade shall be 6 in.

B. Shaping

1. Shape subgrade to a true cross section sufficiently higher than the specified grade to allow for compaction.
2. Rough grading shall be done in a manner that will not leave ridges of material that will interfere with the immediate drainage of water from the subgrade.
3. During shaping and compacting, any high spots or depressions that develop in the subgrade shall be scarified, cut down, or backfilled and compacted as specified below.

C. Wetting and Compacting

1. Furnish sufficient watering equipment to ensure proper moisture content of all materials being placed.
2. Sprinkle each course of material in a manner that will avoid areas of dry material alternated by areas of saturated soil or pools of water.

3.5 PLACEMENT OF FILL ABOVE GRADE

A. Preparation of Ground Surface

1. Where fill is placed over existing pavement or compacted gravel, scarify and compact the existing surface before placing fills.
2. Uniformly moisten areas to receive fill and compact to minimum 90% of maximum density as determined by the Modified Proctor Testing Method.

3.6 COMPACTION

- A. Except as otherwise specified, moisture/density relationships will be as determined by the American Society for Testing and Materials (ASTM) D1557, and the degree of field compaction shall be controlled with ASTM D1556 or ASTM D2922. All tests will be taken by the Buyer.
- B. The Buyer will pay for any test for soil compaction that passes the requirements of the specifications, but the Contractor shall pay for any soil tests that indicate the soil compaction does not meet requirements of the specifications.

3.7 GRADING

- A. Uniformly smooth grade all areas covered by the project, including excavated and backfilled sections, and adjacent transition areas. The degree of finish shall be that ordinarily obtainable from either blade graded or scraper operations.
- B. The finish surface shall be not more than 0.15 ft above or below the established grade or approved cross section.
- C. All drainage swales shall be finished so as to drain readily.

3.8 DISPOSAL OF DEBRIS AND EXCESS MATERIAL

- A. Rubble and debris not suitable for fill shall be transported to a sanitary landfill 1 mile northeast of Access Gate B.
- B. Excess material from excavation, unsuitable for or not required for backfilling, shall be wasted, spread, and leveled or graded as directed by the Buyer within 1 mile of the site.

END OF SECTION 02200

SECTION 03100--CONCRETE FORMWORK

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200, Concrete Reinforcement
- B. Section 03350, Concrete

1.2 APPROVALS: All concrete formwork complete and in place shall be approved by the Buyer before concrete is placed.

PART II: PRODUCTS

2.1 FORMS

- A. Forms for all surfaces shall be made of surfaced lumber, plywood, or material that will provide a surface at least equal to surfaced lumber or plywood.
- B. Forms for all exposed surfaces shall be constructed of plywood or an approved equal. Plywood for forms shall be of the grade Exterior B-B (concrete form) conforming to the latest Product Standard for Soft Plywood, Construction and Industrial, of the National Bureau of Standards.
- C. Plywood panels shall be not less than 5/8 in. thick.
- D. Plywood less than 5/8 in. thick otherwise conforming to the requirements specified herein may be used with a continuous backing of 3/4-in. sheeting.
- E. Metal forms shall be approved by the Buyer.

2.2 MISCELLANEOUS MATERIALS

- A. Form Coating--A colorless mineral oil similar to Horn's form film.
- B. Form ties shall be adjustable in length and be so constructed that no metal will be within 1 in. of finished surfaces after form removal. Wire ties shall not be used where the concrete will be exposed to weathering or to view.

PART III: EXECUTION

3.1 DESIGN REQUIREMENTS: Formwork shall be designed and erected by the Contractor in accordance with the American Concrete Institute (ACI) Recommended Practice for Concrete Formwork (ACI Standard 347) and in accordance with the following:

- 1) Forms shall conform to the shape, lines, and dimensions of members as called for on the drawings and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage of concrete.
- 2) Forms shall be properly braced or tied together to maintain position and shape under load.
- 3) Joints shall be leakproof and arranged vertically.
- 4) Lumber previously used in forms shall have nails withdrawn, and surfaces to be exposed to concrete shall be cleaned before reuse.
- 5) Forms shall be so placed as to be readily removable without hammering or prying against the concrete.

3.2 CORNER FORMS: All vertical and horizontal corners to be exposed when forms are removed shall have a 3/4- X 3/4-in. minimum chamfer unless indicated otherwise on the drawings.

3.3 COATING

- A. Apply two coatings of form oil to forms before placing concrete.
- B. After application, remove surplus oil from forms, and before placing concrete, remove all oil from reinforcing steel.

3.4 REMOVAL OF FORMS AND FALSE WORK

- A. Leave false work and forms in place under structural slabs, beams, and girders for 14 days after the day of the last pour except:
 - 1) When high early strength cement is used, forms for all structures may be removed after 2 days.
 - 2) In cold weather, this length of time shall be determined by the Buyer utilizing test cylinders cured under jobsite conditions.

B. Remove all other forms in not less than 12 hr.

3.5 FILLING HOLES: Holes remaining from bolts or form ties or rods shall be filled solid with cement mortar. All excess mortar at face of filled holes shall be struck-off flush.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE:

- A. Section 03100: Concrete Formwork
- B. Section 03300: Cast-in-Place Concrete

1.2 DELIVERY AND HANDLING:

- A. Deliver steel reinforcement in an undamaged condition, and store away from drainage ways and vehicular traffic.
- B. Handle reinforcement in a manner that will avoid bending or permanent deforming of the bars.

PART II: PRODUCTS

2.1 MATERIALS:

- A. Reinforcement Bars: Conform to American Society for Testing and Materials (ASTM) A-615, Grade 60.
- B. Mesh Reinforcement: Conform to ASTM A-185.

PART III: EXECUTION

3.1 DESIGN: Reinforcing details shown on the Drawings shall govern the furnishing, fabrication, and placing of reinforcement. Construction shall conform to the following requirements:

- A. Quantities and placement of reinforcement shall be in accordance with American Concrete Institute Standard 318 and the Manual of Standard Practice of the Concrete Reinforcing Steel Institute.
- B. Splices:
 - 1. Splices of bars shall be made only where shown on the plans or as approved by the Buyer. Where bars are spliced they shall be lapped at least 30 bar diameters unless otherwise shown on the Drawings.
 - 2. Splicing shall be accomplished by placing the bars in contact with each other and wiring them together.
 - 3. Welding of reinforcing steel will not be permitted unless specifically authorized by the Buyer.

3.2 PLACING OF REINFORCEMENT:

- A. Before placing, thoroughly clean all reinforcement of rust, dirt, mill scale or coatings, and other material which would reduce the bond.
- B. Reinforcement appreciably reduced in section shall not be used.
- C. Following any substantial delay in the work, previously placed reinforcement left for future bonding shall be inspected and cleaned.
- D. Do not bend or straighten reinforcement in a manner that will injure the material.
- E. Heating of reinforcement for bending or straightening will not be permitted.
- F. Torch cutting of reinforcing steel will not be permitted.
- G. Reinforcement shall be accurately placed and securely tied at all intersections and splices with 16-gage black annealed wire and shall be securely held in position during the placing of concrete by spacers, chairs, and approved supports.

END OF SECTION 03200

SECTION 03300
CAST-IN-PLACE CONCRETE

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE:

- A. Section 03100: Concrete Formwork
- B. Section 03200: Concrete Reinforcement

1.2 APPROVALS:

- A. Obtain written approval from the Buyer before placing concrete.
- B. Obtain approval for each individual pour or structure.

1.3 DESIGN CRITERIA:

- A. The design of the concrete mix, that is, the exact proportion of cement, aggregates, additives, and water, shall be the responsibility of the Contractor.
- * B. The proposed mix shall be submitted for approval 10 working days prior to placing concrete.

1.4 ENVIRONMENTAL REQUIREMENTS:

- A. Temperature. Do not place concrete unless the atmospheric temperature in the shade is above 40 degrees F and rising (except as noted below).
- * B. Weather. Do not place concrete in rainy weather.
- C. Cold Weather Concreting:
 - 1. Obtain permission from Buyer before doing any cold weather concreting.
 - 2. Perform concrete work in accordance with American Concrete Institute (ACI) Standard 306 when the mean daily temperature is 40 degrees F or there is a danger of the temperature falling below 32 degrees F.

PART II: PRODUCTS

2.1 MATERIALS:

A. Cement:

1. Portland Cement: Conform to American Society for Testing and Materials (ASTM) C150, Type I or Type II.
2. Air-Entraining Portland Cement: Conform to ASTM C150, Type IA, low alkali.
3. High Early Strength Portland Cement: Conform to ASTM C150, Type III.

B. Aggregate:

1. Aggregate for Regular-Weight Concrete: Conform to ASTM C33.
2. Aggregate for Lightweight Concrete: Conform to ASTM C330.
3. Coarse aggregate shall be 3/4- to 1-1/2-in. maximum size.

C. Water: Clean and potable.

D. Admixtures:

1. Air Entraining: Conform to ASTM C260.
2. Obtain approval for use of admixtures (except air entraining).

E. Expansion Joint Material:

1. For vertical application, use self-expanding cork or sponge rubber conforming to ASTM D1752.
2. For horizontal application, use nonextruding asphalt-impregnated fiber material conforming to ASTM D1751.

F. Curing Materials:

1. Water-Proof Paper: Conform to ASTM C171, Type I or Type II.

- * 2. Polyethylene Sheeting: Minimum 4 mils thick, white color.
- 3. Curing Compound: Conform to ASTM C309, Type 2, having a white-pigmented base.
- G. Non-Shrink Concrete:
 - 1. All non-shrink concrete shall contain one (1) pound of Embeco Aggregate per pound of water that is in excess of two gallons per sack of cement.

2.2 PROPORTIONING OF CONCRETE:

- A. Concrete shall be proportioned in accordance with ACI Standard 301 to attain the required design strength.
- B. Air entrainment shall be used in concrete for all structures that will be exposed to freezing and thawing.
- C. The concrete shall have a slump appropriate for the selected work. Slump shall not be less than 1 in. nor greater than 4 in. except as authorized by the Buyer.
- D. Concrete shall be designed to develop the minimum compressive strength as shown on the Drawings. When the compressive strength is not indicated on the Drawings, it shall be a minimum of 4,000 PSI at 28 days.

2.3 MIXING OF CONCRETE:

- A. Concrete shall be mixed in accordance with ACI Standard 301.
- * B. Transit-mixed concrete shall be mixed and delivered in accordance with ACI Standard 304.
- C. When necessary for proper control of concrete, mixing of transit-mixed concrete shall be done at site of concrete placement.

PART III: EXECUTION

3.1 PREPARATION FOR PLACING CONCRETE:

- A. Remove water and mud from excavation.
- B. Remove hardened concrete, wood chips, ice, and other debris from the interior of forms.

- C. Oil or wet forms just prior to placing concrete.
- D. Notify other crafts so they may deliver anchors for other work. Obtain their assistance in setting anchors if required.
- E. Moisten absorptive foundations against which concrete will be placed.

3.2 PLACING CONCRETE:

- A. Concrete shall be placed in accordance with ACI Standard 301.
- * B. Concrete shall be placed in forms within 60 min. from the time of introduction of cement and water.
- C. Do not retemper concrete.
- D. Deposit concrete as close as practicable to its final position. Do not drop concrete more than 5 ft.
- E. Place concrete in continuous horizontal layers; the depth of each layer shall not exceed 12 in.

3.3 MECHANICAL AGITATION:

- A. Immediately after depositing, compact the concrete by means of mechanical vibrators. Slabs may instead be compacted by means of grid tampers when approved by the Buyer.
- B. Vibrator shall be flexible electric type or approved compressed-air type.
- C. Do not place vibrator against reinforcing or forms or use vibrator to transport concrete within forms.

3.4 FINISHING CONCRETE:

- A. Smooth Finish: Give smooth finish to all exterior concrete surfaces, except slabs, that will be exposed to view.
 - 1. Thoroughly wet and then brush coat surfaces with cement grout (one part Portland cement to two parts fine aggregate mixed with water to consistency of thick paint).

2. Spread grout with sponge or wood float to fill all pits and surface irregularities.
 3. Scrape off excess grout and rub surface with burlap to remove visible grout film.
 4. In hot weather, keep grout damp by means of fog spray during the setting period.
- B. Rubbed Finish: Give rubbed finish to interior concrete surfaces, except slabs, that will be exposed to view.
1. Give smooth finish as specified above, then rub with carborundum stones and water.
 2. Do not use mortar or grout during rubbing.
 3. Remove excess mortar that is worked up during rubbing.
- C. Monolithic Slab Finish: Give monolithic finish to interior floor slabs.
1. Compact fresh concrete and screened to required elevation.
 2. Float to a true, even plane with no coarse aggregate visible.
 3. After surface moisture has disappeared, steel trowel floor slab to a smooth, even finish, free from trowel marks.
- D. Broomed Finish: Give broomed finish to all trading surfaces of docks, walks, and steps exterior to the building.
1. Give monolithic finish as specified above, except immediately after steel troweling brush surface with a stiff bristle brush.
 2. Brush in parallel strokes at right angles to the normal flow of traffic.
- E. Slab Flatness Tolerances: Finished cast-in-place slabs shall not vary more than 1/8 in. from a 10-ft. straightedge.

3.5 CURING

Protect concrete against loss of moisture for at least 7 days by using one of the following methods for the surfaces indicated:

- A. Vertical Surfaces and Under Surfaces of Beams and Elevated Slabs:
 - 1. Moist cure with forms in place for the full curing period, or
 - 2. Cover with wet burlap, or
 - 3. Fog spray.
- B. Slabs Ongrade and Floor Slabs:
 - 1. Cover with water-proof curing paper or polyethylene sheet, lapped 4 in. at joints and sealed with tape or
 - 2. Cover with burlap or cotton mats and keep such covering continuously wet.
- C. Exterior Walks, Docks, and Stairs:
 - 1. Apply curing compound in a two-coat continuous operation using a minimum of 1 gal. per 200 ft² for each coat. Apply second coat at right angles to direction of first coat or
 - 2. use method indicated in paragraph A above.
 - 3. Do not use curing compound on concrete surface to which future concrete will be bonded.

3.6 PATCHING:

- A. Immediately after removal of forms, remove all fins and loose material.
- B. Chip out to solid concrete all honeycomb, aggregate pockets, and voids over 3/4 in. in diameter.
- C. Fill chipped holes with epoxy mortar or neat cement grout. Finish holes flush to adjacent surfaces.
- D. Damp cure patchwork for 72 hr.

3.7 FIELD QUALITY CONTROL:

A. Sample-Taking:

1. Preparation of concrete samples and testing of such samples shall be the responsibility of the Buyer.
2. The Contractor shall provide assistance in obtaining concrete samples.
3. The Buyer may take three test cylinders from each placement of 50 yd³ or fraction thereof.

B. Compression Tests:

1. Test cylinders shall be made in accordance with ASTM C31 and tested in accordance with ASTM C39.
2. One cylinder will be tested at 7 days, one at 28 days, and one retained as a spare.

C. Slump Tests: Slump of concrete shall be determined at point of discharge from the mixer in accordance with ASTM C143.

END OF SECTION 03300

SECTION 03600

GROUT

PART I: GENERAL

1.1 DELIVERY AND STORAGE

Store all grouting materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

PART II: PRODUCTS

2.1 GROUT

- A. Composition shall be one part Portland cement and three parts sand.
- B. Add water to create a stiff mixture.
- C. Minimum compressive strength shall be 1,500 PSI at 28 days.
- D. Discard grout not placed after 1 1/2 hr.

PART III: EXECUTION

3.1 GROUTING

- A. Pack grout tightly around well casings, pipe or conduit in penetrations through masonry or concrete walls.
- B. Smooth exposed surfaces of grout to blend with adjacent surfaces.

END OF SECTION 03600

SECTION 03601

NONSHRINK GROUT

PART I: GENERAL

- 1.1 DELIVERY AND STORAGE: Store all nonshrink grouting materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

PART II: PRODUCTS

2.1 MATERIALS:

- A. Nonshrink grout for setting column bases, anchor bolts, equipment, and other items shown on the Drawings shall be one of the following types:
 - 1. EMBECO (premix): As manufactured by Master Builders Company.
 - 2. Ceilcote 648: As manufactured by The Ceilcote Company, Inc.
- B. Adhesive for Ceilcote Grout: Ceilcote 348 Adhesive Fast Set as manufactured by The Ceilcote Company, Inc.
- C. Portland Cement: Conform to American Society for Testing Materials (ASTM) C150, Type I.
- D. Sand: Conform to ASTM C33, Fine Aggregate.
- E. Pea Gravel: Conform to ASTM C33, Coarse Aggregate, graded so that at least 90% passes 3/8-in. sieve and 90% is retained by a No. 4 sieve.

2.2 MIXES:

- A. EMBECO Grout:
 - 1. For less than 2-in. clearances or where size or shape of space makes grouting difficult, use standard EMBECO grout and water.
 - 2. For greater than 2-in. clearances where coarse aggregate will not obstruct free passage of the grout, use EMBECO grout with 3/8-in. aggregate (premixed).
 - 3. Use the minimum amount of water necessary to produce a flowable grout without causing either segregation or bleeding. After the grout has been mixed, do not add more water for any reason.

- B. Ceilcote Grout: Mix according to manufacturer's instructions.
- C. Portland Cement Mortar for Raked-Out Edges of EMBECO Grout: one part Portland cement, two parts sand, and 0.50 parts water by weight.

PART III: EXECUTION

3.1 FORMWORK:

- A. Build leakproof forms that are strong and able to withstand grout pressures.
- B. Provide enough clearance between the formwork and the area to be grouted to permit proper placement of grout.

3.2 SURFACE PREPARATION:

- A. Clean concrete surfaces to be grouted of all defective concrete, dirt, oil, grease, and other foreign matter.
- B. Lightly roughen the concrete.
- C. Remove grease and foreign materials from all steel surfaces in contact with grout.
- D. Align, level, and maintain final positioning of all components to be grouted.
- E. Saturate all concrete surfaces with clean water, remove excess water, and leave none standing.

3.3 PLACING:

- A. Place nonshrink grouting quickly and continuously by the most practical means permissible: pouring, pumping, or under gravity pressure. Do not use either pneumatic-pressure or dry-packing methods without written permission from the Buyer.
- B. Where practical, apply grout from one side only to avoid entrapping air.
- C. Do not vibrate the placed grout mixture or allow it to be placed if the area is being vibrated by nearby equipment.
- D. Do not remove leveling shims for at least 48 hr. after grout has been placed.
- E. After the EMBECO grout has reached initial set, rake out all exposed edges approximately 1/2 in. into the grouted area and point with cement-sand mortar or grout.

SECTION 05400--LIGHTGAGE FRAMING

PART I: GENERAL

SUBMITTALS: Submit erection manual and catalog data for substitute manufacturer. See Section 01300, Submittals.

PART II: PRODUCTS

2.1 MANUFACTURER: Lightgauge framing shall be as manufactured by the Porta Fab Corporation.

2.2 MATERIALS

A. Framing members shall be of the depth and gage shown on the drawings. Studs and joists shall be punched for passage of concealed wiring.

B. Gypsum Board--See Section 09250.

2.3 FINISH: All light-gauge steel members shall be galvanized.

PART III: EXECUTION

3.1 INSTALLATION

A. Studs shall be set 16 in. oncenter and spaced by bridging as shown on the drawings.

B. Finished framing shall be plumb, neat in appearance, and free from defects.

3.2 FIELD CONNECTION

A. Welded as recommended by the manufacturer.

B. Self-drilling, self-tapping sheet metal screws or bolts.

END OF SECTION

SECTION 05500

STRUCTURAL AND MISCELLANEOUS STEEL

PART I: GENERAL

1.1 REQUIREMENTS OF REGULATORY AGENCIES

- A. The design, detailing, fabrication, and erection of steelwork shall conform to American Institute of Steel Construction (AISC) "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings."
- B. Welding shall conform to American Welding Society (AWS) "Structural Welding Code - Steel," D1.1.

1.2 QUALIFICATIONS

- A. Welding procedures, welders, welding operations, and trackers shall be qualified in accordance with AWS Code D1.1.
- B. Submit to the Buyer the names of welders to be employed in the work together with approved certification.

1.3 SUBMITTALS

- A. Shop Drawings
 - 1. Submit shop drawings indicating all shop and erection details, including cuts, copes, connections, holes, threaded fasteners, rivets, and welds.
 - 2. All welds, both shop and field, shall be indicated by AWS "Welding Symbols," A2.4.
- B. Erection Procedure. Submit descriptive data to illustrate the structural steel erection procedure, including the sequence of erection and temporary staying and bracing.
- C. Manufacturer's Literature. Submit description of each type of welding stud and arc shield.
- D. Submit manufacturer's installation requirements for drilled anchors.

1.4 PRODUCT HANDLING

- A. Deliver anchor bolts and other items to be set in concrete or masonry in ample time before need.
- B. Store steel members above-ground on platforms or skids.

PART II: PRODUCTS

2.1 MATERIALS

- A. Steel Shapes, Bars, and Plates. Conform to American Society for Testing and Materials (ASTM) A36.
- B. Galvanizing. Conform to ASTM A123, A386, and ASTM Recommended Practices A384, A385.
- C. Metal-Arc Electrodes. Conform to ASTM A233, AWS A5.1.
- D. Fasteners and Anchors
 - 1. Standard Bolts and Nuts: ASTM A307, Grade A.
 - 2. High-Strength Threaded Fasteners: ASTM A325.
 - 3. Rivets: ASTM A502, Grade 1.
 - 4. Anchor Bolts: Conform to Section 1.3, ASTM A-307.
 - 5. Drilled Anchors: Hilti fastening systems or ITT Phillips Red head anchors.
 - 6. Piston Drive Anchors and/or Powder-Actuated Anchors: Hilti fastening systems.

2.2 FABRICATION

- A. General
 - 1. Connections shall be as indicated on the drawings. Connections not indicated shall be made in accordance with AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings."
 - 2. All cutting of metal shall be true to the lines required, and all burrs and sharp edges shall be removed.

3. Holes shall be cut, punched, or drilled at right angles to the surface of the metal and shall not be enlarged by burning. Holes in base plates or bearing plates shall be drilled.

B. Welding

1. Welded construction shall conform to AWS Code D1.1.

C. Painting. Do not paint steelwork to be encased in concrete. All other steelwork shall be given one coat of shop paint as follows:

1. Clean steelwork by hand wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt, and other foreign matter. Remove oil and grease deposits with solvent.
2. Prime steelwork with one coat of oil-base rust-inhibitive metal primer.
3. Parts inaccessible after assembly shall be given two coats of shop paint as specified above.
4. Where practical, do not prime surfaces that are to be welded after erection. If painted, remove paint before field welding at least 2 inches beyond either side of the joints. After welding, field paint to match adjacent surfaces.

PART III: EXECUTION

3.1 ERECTION OF STRUCTURAL STEEL

A. Bolting

1. Protect bolt heads from damage during erection.
2. Provide bolts installed on beveled surfaces with beveled washers to give full bearing to bolt heads and nuts.
3. Provide bolts of lengths that will extend entirely through, but no more than 1/4 inch beyond the nuts. Draw nuts tight against the work. Upset threads after tightening to prevent loosening.

4. High-strength bolting shall conform to the AISC "Specification for Assembly of Structural Joints Using High Strength Steel Bolts."
- B. Anchor Bolts. Preset into built-in work by using templates or other means necessary to accurately locate these items.
- C. Drilled anchors as per manufacturer's instructions.
- D. Base plates and bearing plates requiring grouting:
 1. Support and align on steel wedges or shims. Cut wedges and shims off flush with edge of base and leave in place.
 2. After the supported members have been positioned, plumbed, and anchor nuts tightened, grout the entire bearing area as specified in Section 03600, Grout.
- E. Alignment
 1. After assembly, align and adjust the various members of a completed frame or structure before final fastening.
 2. Fasten the splices of compression members after abutting surfaces have been brought completely into contact.
 3. Before assembly, clean, and remove burrs from bearing surfaces and from surfaces that will be in permanent contact.
 4. Correct poor matching of holes by redrilling to the next larger size. Do not weld for redrilling or burn unfair holes to correct for poor matching of holes.
 5. As erection progresses, secure the work to take care of all dead loads, wind, and erection stresses until permanent connections are completed.
 6. Tighten field bolts and leave in place unless removal is required, in which case fill holes flush with plug welds.
- F. Drift pins may be used to bring parts into alignment, but do not use in a manner that will distort or damage the metal.

- G. Do not use a gas cutting torch in the field for correction of fabrication errors unless written approval has been obtained from the Buyer.

3.2 FIELD QUALITY CONTROL

- A. The Contractor shall perform the following:
 - 1. Qualification of field welding procedures and personnel.
 - 2. Inspection of erected structural steelwork for conformance with the requirements specified.
 - 3. Witness and approve all anchor installations.
- B. Inspection of field-assembled high-strength bolted construction shall be in accordance with Section 6, AISC Specification for Structural Joints.
- C. Inspection of welds shall be in accordance with Section 6 of AWS Code D1.1.

END OF SECTION 05500

SECTION 07900--CAULKING AND SEALANTS

PART I: GENERAL

1.1 LOCATION: Apply sealant around the following locations:

- 1) Door frames and thresholds
- 2) Expansion joints
- 3) Roofing penetrations, collars, and flashings
- 4) Elsewhere as shown on the drawings

1.2 DELIVERY AND STORAGE OF MATERIALS

- A. Deliver and store materials in original packages until ready to use.
- B. Store in a manner that will prevent damage by water, freezing, breakage, or contact with foreign materials.

PART II: PRODUCTS

2.1 MATERIALS

- A. Silicone Sealant--Silpruf, one part primerless silicone sealant, as manufactured by General Electric.
- B. Silicone Sealant--Construction 1200, one part primerless high modulus sealant as manufactured by General Electric.
- C. Backup Rod
 1. Backup rod shall be an extruded, flexible, compressible, polyethylene foam, designed for backup of elastomeric cold applied sealants.
 2. Diameter: 25% to 50% greater than the joint width.
- D. Bond Breaker--Polyvinyl chloride electrical tape with adhesive back.
- E. White Oakum--Twisted jute packing to commercial standards, embedded with bentonite.
- F. Sealants--Shall be tested according to UL-723 "Test for Surface Burning Characteristics".

PART III: EXECUTION

3.1 PREPARATION

- A. Surfaces of joints to be sealed shall be clean, dry, and free from oil, dirt, frost, and foreign matter.

- B. Use backup rod for wide joints when recommended by manufacturer of sealant.
- C. Ambient temperature shall be between 40° and 100°F when sealant is applied.
- D. Thoroughly wash concrete and masonry surfaces to remove soluble alkaline salts.
- E. Clean metal surfaces of corrosion by wire brushing or using chemical cleaners.

3.2 APPLICATION

A. General

- 1. Sealant shall be uniformly smooth and free of wrinkles.
- 2. Apply sealant sufficiently convex to result in a flush joint when dry.
- 3. Follow manufacturer's recommendations.

B. Door Frames

- 1. Apply sealant bead around frames in concrete or masonry walls.
- 2. Gaps larger than 1/2 in. between frame and opening shall be grouted in by other trades.

C. Thresholds

- 1. Set metal thresholds in sealant bed at least 1/8 in. thick.
- 2. Secure threshold in place with minimum of three expansion screws.
- 3. Remove excess sealant around edges.

D. Expansion Joints--Clean joints, apply bond breaker, and apply silicone sealant.

3.3 CLEANUP: Clean all sealant from adjacent surfaces.

END OF SECTION

SECTION 07901--PIPE PENETRATIONS

PART I: GENERAL

- 1.1 LOCATION: Apply caulking or sealant as follows: at pipe, duct, and conduit penetrations; exterior and interior walls; ceilings; floor slabs; penetrations between contaminated and uncontaminated zones; and as noted unless otherwise shown on the contract drawings.
- 1.2 DELIVERY AND STORAGE OF MATERIALS
 - A. Deliver and store materials in original packages until ready to use.
 - B. Store in a manner that will prevent damage by water, freezing, breakage, or contact with foreign materials.

PART II: PRODUCTS

2.1 MATERIALS

- 2.1.1 Caulk--3M Brand Fire Barrier Caulk CP-25.
- 2.1.2 Silicone Foam--Dow Corning 3-6548 Silicone RTV Foam.
- 2.1.3 Polyurethane Sealant--For floors use Vulkem 45 as manufactured by Mameco International, one part, pourable, primerless, self-leveling sealant, gray in color, and conforming to Federal Specification TT-S-00230 C, Type 1 (Class A).
- 2.1.4 White Oakum--Twisted jute packing to commercial standards, imbedded with bentonite.
- 2.1.5 Pipe Sleeve--Schedule 40 galvanized pipe or fabricated from zinc-coated steel sheet having a nominal weight of not less than 1.656 psf. Length shall be sufficient to pass through the entire thickness of the wall and/or floor.
- 2.1.6 Conduit Seal--Fitting shall be EZS horizontal or EYS vertical seal fitting as supplied by Crouse-Hinds.
 - a. Sealing compound shall be a Chico A as supplied by Crouse-Hinds.
 - b. Packing fiber shall be Chico X as supplied by Crouse-Hinds.

PART III: EXECUTION

3.1 PENETRATION METHODS

3.1.1 New Concrete Walls

Cast sleeve in place. Sleeve sizing shall be one inch larger than electrical conduit, pipe, or air duct dimension. Square or rectangular

duct sleeves shall be of sufficient wall thickness and temporarily braced to prevent distortion during casting period.

3.1.2 Existing Concrete Walls

Core drill for conduit or pipe or saw cut hole for rectangular duct, a minimum of 1 in. larger than electrical conduit, pipe, or air duct dimensions.

3.1.3 New and Existing Masonry Block Walls (with cells grouted solid)

Same as "Existing Concrete Walls," paragraph 3.1.2.

3.1.4 New and Existing Masonry Block Walls (with hollow cells)

Core drill or saw cut for sleeve. Sleeve sizing shall be as described in paragraph 3.1.2.

3.1.5 New Concrete Floors (other than floors on grade)

Cast sleeve in place. Sleeve sizing shall be as described in paragraph 3.1.1.

3.1.6 Existing Concrete Floors (other than floors on grade)

Core drill to the nearest common hole diameter or saw cut to accommodate sleeve. Sleeve hole shall be a minimum of 1 in. larger than electrical conduit, pipe, or air duct sleeve.

3.1.7 Light-Gage Metal Walls and Permanent-Type Ceilings

Core drill or saw cut to match outside dimension of electrical conduit, pipe, or air duct.

3.1.8 Banker Partitions and Suspended Ceilings

Core drill or saw cut for conduit, pipe, or air duct. Sealing is not required.

3.1.9 Light-Gage Metal Stud Walls

Core drill or saw cut for sleeve. Pipe or duct sleeve sizing shall be as described in paragraph 3.1.1. Flanges are required on both ends of finished wall surfaces. Attach flanges with through bolts.

3.2 SURFACE PREPARATION

3.2.1 Surfaces to be sealed shall be clean, dry, and free from oil, dirt, frost, and foreign matter. Fresh concrete to be sealed shall have cured for at least 7 days prior to application of caulk or sealants.

3.2.2 Ambient temperature shall be above 40°F and below 100°F when sealant is applied.

3.2.3 Clean all metal surfaces of corrosion by wire brushing or using chemical cleaners.

3.3. SEALING METHODS

Two methods are given for each condition. Either method is acceptable. Special effort shall be made to concentrically locate and seal conduit, pipe, or duct in sleeve.

3.4 NEW CONCRETE WALLS

3.4.1 The space between the electrical conduit, pipe, or air duct and the sleeve shall be firmly packed with white oakum and sealed on both ends with a minimum depth of 1 in. caulk.

3.4.2 The space between the electrical conduit, pipe, or air duct and the sleeve shall be dammed at both ends and sealed with silicone foam per manufacturer's recommended procedures.

3.5 EXISTING CONCRETE WALLS

3.5.1 The space between the electrical conduit, pipe, or air duct and the core-drilled or saw-cut hole shall be firmly packed with white oakum and sealed on both ends with a minimum depth of 1 in. caulk.

3.5.2 The space between the electrical conduit, pipe, or air duct and the core-drilled or saw-cut hole shall be sealed with silicone foam per manufacturer's recommended procedures. No sleeve required.

3.6 NEW AND EXISTING MASONRY BLOCK WALLS (with cells grouted solid)

Same as paragraph 3.5, "Existing Concrete Walls."

3.7 NEW AND EXISTING MASONRY BLOCK WALLS (with hollow cells)

3.7.1 The space between the electrical conduit, pipe, or air duct and sleeve shall be firmly packed with white oakum and sealed on both ends with a minimum depth of 1 in. caulk.

3.7.2 The space between the electrical conduit, pipe, or air duct and the sleeve shall be sealed with silicone foam per manufacturer's recommended procedures.

3.7.3 The space between the sleeve and the drilled or cut hole shall be filled solid with nonshrink grout.

3.8 NEW CONCRETE FLOORS (other than floors on grade)

The space between the electrical conduit, pipe, or air duct and the sleeve shall be firmly packed with white oakum and sealed on both ends with a minimum depth of 1 in. polyurethane sealant or caulk.

3.9 EXISTING CONCRETE FLOORS (other than floors on grade)

3.9.1 The space between the electrical conduit, pipe, or air duct and the sleeve shall be firmly packed with white oakum and sealed on both ends with a minimum depth of 1 in. polyurethane sealant or caulk.

3.9.2 The space between the sleeve and the drilled or cut hole shall be filled solid with nonshrink grout.

3.10 LIGHT GAGE METAL WALLS

Seal between electrical conduit, pipe, or air duct and drilled or cut opening with a 1/4-in. bead of caulk.

3.11 PERMANENT TYPE CEILINGS

Seal between electrical conduit, pipe, or air duct and drilled or cut opening with a 1/4-in. bead of caulk.

3.12 LIGHT GAGE METAL STUD WALLS

3.12.1 The space between the electrical conduit, pipe, or air duct and the sleeve shall be firmly packed with white oakum and sealed with a minimum of 1-in. deep of caulk.

3.12.2 The space between the electrical conduit, pipe, or air duct and the sleeve shall be sealed with silicone foam per manufacturer's recommended procedures.

3.12.3 The space between the flange and wall shall be sealed with 1/4-in. bead of caulk.

3.13 SEALANT/CAULK APPLICATION

3.13.1 Sealant/caulk shall be applied uniformly smooth and free of wrinkles.

3.13.2 Apply sealant/caulk sufficiently convex to result in a filled joint that is flush after the sealant has cured.

END OF SECTION

SECTION 08100--HOLLOW METAL DOORS AND FRAMES

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 08700, Finish Hardware
- B. Section 09900, Painting

1.2 QUALITY CONTROL--CERTIFICATIONS

- A. Furnish certification of label construction for doors not requiring labels but requiring labeled construction.
- B. Heat transmission test shall be certified by an approved independent testing laboratory.

1.3 SUBMITTALS--SHOP DRAWINGS

- A. Submit shop drawings covering each type of door and frame, frame conditions, and complete anchorage details, supplemented by suitable schedules covering doors and frames.
- B. Show glass and louver opening sizes and locations in doors.
- C. Indicate size, gage, and location of reinforcement for hardware on drawings.
- D. Detail connections of hollow metal work to structural steel framing concealed in hollow metal work.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle hollow metal work in a manner to prevent damage and deterioration.
- B. Store doors upright in a protected dry area at least 1 in. off the ground or floor and at least 1/4 in. between individual pieces.
- C. Protect exposed finish surfaces of prefinished items with masking tape.

PART II: PRODUCTS

2.1 BASIC MATERIAL

- A. Sheet steel for frames shall be hot-rolled carbon steel.

- B. Sheet steel for doors shall be cold-rolled stretcher level sheet steel.

2.2 FRAMES

- A. Frames for new and existing concrete and masonry opening shall be rough buck and cabinet jamb type. If an existing opening is too small to accept a standard rough buck jamb, a combination jamb may be used.
- B. Frames for metal stud walls shall be combination buck, frame, and trim type.
- C. Minimum Gage--16 gage for all frames.
- D. Corner joints shall have all contact edges closed tight with faces and stops continuously welded and ground smooth. Knockdown-type frames are not acceptable except for rough buck and cabinet jamb type.
- E. Form 5/8-in. minimum stop integral with frame.
- F. Provide three holes for each strike jamb and two holes for header of double frames for application of door silencers.
- G. When possible, provide frames with 14-gage floor clips welded to each jamb member.
- H. Provide two 16-gage steel spreaders for double-rabbeted frames tack welded to the bottom of both jambs.
- I. Anchors
 - 1. Masonry Anchors: Provide frames anchored into masonry with four 3/8-in. J-bolts per rough buck jamb for doors to 7 ft and one additional anchor per jamb for each 18 in. of height over 7 ft.
 - 2. Steel Stud Anchor: Provide frames anchored to steel studs with three 16-gage Z-shaped anchors per jamb for doors to 7 ft and one additional anchor per jamb for each 18 in. of height over 7 ft.
 - 3. Bolt Anchors: Provide frames anchored into existing conditions with four 3/8-in. minimum-bolt-type anchors per rough buck jamb for doors to 7 ft and one additional anchor per jamb for each 18 in. of height over 7 ft.

2.3 DOORS

- A. All doors shall be 1 3/4 in. thick with continuously welded edges, dressed and ground smooth and with no visible seams on door faces or vertical edges.

- B. Face sheets shall be 18-gage steel for doors up to 3 ft 6 in. wide. Doors 3 ft 6 in. and wider shall have 12-gage face sheets, except where label requirements specify 18 gage.

C. Internal Stiffeners

1. Surface sheets shall be supported by Z-channel or continuous truss members not less than 18 gage (28 gage for continuous truss), spaced not more than 6 in. on center and internally spot welded to both surface sheets not more than 4 in. on center.
2. Top and bottom edges of all doors shall be closed flush with continuous 18-gage channel members extending full width of door.
3. Edges of doors shall be supported by 18-gage interior edge channels extending full height of door.

- D. Interior surfaces of door shall be treated with a sound-deadening material to eliminate metallic ring.

E. Clearances

1. Between doors and frames at head and jamb, 1/8 in.
2. At sill where no threshold is used, 1/2 in. Where threshold is used, 1/8 in. between door and threshold.
3. Between meeting edge of doors in pairs, 1/8 in.
4. Bevel edges of single-acting doors, 1/8 in. in 2 in.

F. Glass Molding

1. Doors to be glazed shall be provided with 18-gage molding to secure glass. Molding shall have all corners fully mitered and welded.
2. Glazing bead shall be permanently secured to the exterior side of the door by concealed internal welding. Interior glazing bead shall be held in place with countersunk, oval-head screws.

G. Louvers

1. Louvers shall be 18 gage inverted chevron type unless otherwise noted on door schedule.
2. Louvers shall be welded to frame and securely fastened beneath the door face sheets to conceal louver moldings.

2.4 PREPARATION FOR FINISH HARDWARE

- A. Doors and frames shall be factory-reinforced, drilled, and tapped for mortise template hardware in accordance with the approved hardware schedule. Obtain current hardware templates from hardware supplier.

B. Provide welded-in reinforcing plates for surface-applied hardware.

C. Frame Reinforcement--Thicknesses and sizes for frame reinforcement shall be as follows:

1. Butt Hinges: 3/16-in. plate 9 in. long and full width of the frame profile.
2. Closer: 12-gage channel section 12 in. long and full width of frame trim.
3. Reinforcements for Strikes, Flush Bolts, and All Other Surface-Mounted Hardware: 12 gage.

END OF SECTION

SECTION 08700--HARDWARE AND SPECIALTIES

PART I: GENERAL

1.1 SUBMITTALS

- A. Submit complete listing of hardware to be furnished showing:
 - Door mark number
 - Government number or manufacturer specified
 - Size (where applicable)
 - Finish
 - Proposed manufacturer and catalog number
 - Quantity of each item
- B. Furnish manufacturer's literature for each item for evaluation of products.

1.2 DELIVERY

- A. Deliver hardware items to project site in manufacturer's original packages.
- B. Hardware for each door shall be separately packaged and marked with the respective door mark number.

1.3 PROTECTION

- A. Protect finish hardware from damage and marring of finish.
- B. Any hardware which becomes damaged or marred prior to final acceptance shall be replaced with new, identical items.

- 1.4 CERTIFICATION: Hardware for fire-rated doors shall bear the Underwriters' Laboratories, Inc. (UL), label.

PART II: PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Door hardware shall be the standard products of the following manufacturers:
 - Best
 - Corbin
 - Von Duprin
 - Stanley
 - Russwinn

- B. Substitute manufacturers will be accepted only by submittal when approved manufacturer is not available.

2.2 MATERIALS

A. Butt Hinges

1. Butt hinges shall be heavy-duty wrought steel, full mortised, five knuckle ball bearing, nonrising (and on exterior doors nonremovable), loose-pin hinges.
2. Conform to Federal Specification FF-H-16c, Type T2115 (Stanley FBB-168).
3. Furnish three 4 1/2- X 4 1/2-in. butts for each door unless otherwise specified.

B. Closers

1. Closers shall be compact overhead surface-mounted type with separate spring power adjustment for general and latching speed.
2. Conform to Federal Specification FF-H-121c, Type 3001, Size V (Norton Series 1600).
3. Furnish regular arm with closer unless hold-open or fusible-link feature is specified in the hardware schedule.

C. Locksets

1. Locksets and latchsets shall be cylindrical, full-mortise types.
2. Conform to Federal Specification FF-H-00106b, Series 86, with 4S trim (Corbin 7500 series with antifriction latchbolt).
3. The function for each lockset shall be as specified in the hardware schedule.

D. Exit Devices

1. Exit (panic) devices shall be mortise-lock types. Vertical-rod exit devices shall have rods completely concealed in door.
2. Conform to Federal Specification FF-H-00106b, Series 820 (Von Duprin 8800 series).
3. The function for each exit device shall be as specified in the hardware schedule.

E. Flush Bolts

1. Flush bolts shall be made of forged brass or bronze and have standard 12-in. length.

2. Conform to Federal Specification FF-H-00111b, Type 1045 (Sargent 3470).

3. Furnish bottom flush bolt with dust-proof recessed strike.

F. Door Stops

1. Wall stops shall be of forged brass or bronze and conform to Federal Specification FF-H-00111b, Type 1320 (Sargent 3372).

2. Floor stops shall be of forged brass or bronze and conform to Federal Specification FF-H-00111b, Type 1328 (Sargent 3374).

G. Fastenings of suitable size, quality, and type shall be provided to secure hardware in position. Machine screws and expansion shields shall be provided for securing items of hardware to concrete or masonry.

H. Miscellaneous materials and components (coordinating devices, kick-plates, etc.) not indicated in this article shall be as specified in the hardware schedule.

2.3 FINISH: The exposed surfaces of all finish hardware items shall be dull bronze, U.S. 10, unless otherwise specified.

2.4 KEYING

A. All locksets and deadbolts shall be a type that will accept Best 1E64 cylinder.

B. Cores and keys will be furnished and installed by the Buyer.

C. Cylinders shall be furnished and installed by the Buyer.

PART III: EXECUTION

3.1 HARDWARE INSTALLATION

A. Install hardware items in accordance with manufacturer's recommended instructions and templates.

B. Hinges

1. Install top hinge with center of hinge not more than 9 in. below top of door.

2. Install bottom hinge with center of hinge not more than 12 in. above finish floor.

3. Install intermediate hinges equidistance between top and bottom hinges.

C. Door Closers

1. Install in accordance with templates and instructions furnished by manufacturer.
2. Mount closer on room side of door.

D. Locks, Latches, and Strikes--Center strike of knob locks and knob latches 40 1/2 in. above finish floor.

E. Weatherstripping

1. Install on metal frames and doors in accordance with installation instructions furnished.
2. Fit tightly at corners to maintain continuity around door.

3.2 CLEANING AND ADJUSTING

- A. Before final acceptance, clean and adjust all hardware.
- B. Demonstrate correct function of hardware in presence of the Buyer.

3.3 HARDWARE SCHEDULE

- A. The quantity, function, and other requirements of finish hardware items for each door are noted on the hardware schedule.
- B. Hardware for each door is identified by a door mark as shown on the drawings.

END OF SECTION

SECTION 09250

GYPSUM DRYWALL

PART I: GENERAL

1.1 DELIVERY AND STORAGE OF MATERIALS:

- A. Deliver manufacturer's original containers, bundles, or packages to jobsite with seals unbroken and labels intact.
- B. Store materials in an approved manner and protect from contact with soil and exposure to the elements.

1.2 ENVIRONMENTAL CONDITIONS:

- A. Cold Weather: Heat the building before and during the application of the joint system to maintain a minimum uniform temperature of 55 degrees F.
- B. Moisture: Provide ventilation to eliminate excessive moisture.

1.3 PROTECTION: Protect adjacent work and equipment from damage during wallboard application and joint treatment.

PART II: PRODUCTS

2.1 MATERIALS:

A. Gypsum Wallboard:

- 1. Conform to American Society for Testing and Materials (ASTM) C36.
- 2. Gypsum wallboard for general use shall be 1/2 in. thick with tapered edges.
- 3. Type "X" (special fire retardant) wallboard shall be 5/8 in. thick with tapered edges, UL listed.
- 4. Provide in 4-ft. widths and in lengths as long as practical to eliminate butt joints.

B. Joint Tape: Conform to ASTM C475--Perf-A-Tape as manufactured by United States Gypsum.

C. Joint and Finishing Compounds:

- 1. Conform to ASTM C475.
- 2. Use Perf-A-Tape Joint Compound (or All-Purpose Ready-Mixed Compound) for embedding and first-coat application.

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3. Use Perf-A-Tape Topping Compound (or Perf-A-Tape Ready-Mixed Topping Compound) for fill and finishing.
 - D. Inside and outside vertical corner reinforcement shall be as manufactured by United States Gypsum.
 - E. One-inch drywall screws, Type S, shall be used to attach drywall to steel studs or furring channels in conventional construction.
- 2.2 MIXING OF JOINT AND FINISHING COMPOUNDS:
- A. Mix and use joint and finishing compounds in accordance with manufacturer's recommendations as shown on the bag.
 - B. Use ready-mixed materials as they come in original containers.

PART III: EXECUTION

- 3.1 GENERAL: Installation of gypsum wallboard shall be in accordance with American National Standards Institute Standard A97.1, The Application and Finishing of Wallboard, and the following.
- 3.2 INSTALLATION OF GYPSUM WALLBOARD:
- A. Drive screws so that the top of the screwhead is just below the wallboard surface without breaking the surface paper of the wallboard or stripping the framing member around the screw.
 - B. Space screws 3/8 in. to 1/2 in. from the ends and edges of the wallboard. Space screws at 12 in. on center for framing members.
- 3.3 JOINT TREATMENT:
- A. Installation of Joint Tape:
 1. Using a suitable tool or machine, apply a thin, uniform layer of Perf-A-Tape Joint Compound, approximately 3 in. wide, over the joint to be reinforced.
 2. Center Perf-A-Tape over the joint and set into the compound leaving sufficient compound under the tape to provide proper bond. Recommended procedure is to apply a skim coat of compound after embedding tape.
 3. Reinforce inside and outside vertical corner angles with the Perf-A-Tape folded to conform to adjoining surfaces and to form a straight, true angle. After drying, cover the Perf-A-Tape with one coat of topping.

4. Clean excess compound from the surface of the wallboard and allow all joints to dry a minimum of 24 hr. between each application of compound.

B. Application of Joint and Topping Compound:

1. Apply one coat of joint compound before or after hardening is complete in the embedding coat.
2. Apply two coats of topping compound over the joint compound. Spread each coat evenly over and slightly beyond the tapered edge area of the wallboard, and feather at the edges.
3. Apply each coat with a smooth, uniform slight crown over the joint and with the edges feathered slightly beyond the preceding coat.

C. Where Dur-A-Bead corner reinforcing is used, apply at least two coats of compound over the reinforcing as outlined in paragraph B above. When completed, the compound shall extend approximately 8 to 10 in. on either side of the exposed metal nosing.

D. Where Perf-A-Bead corner reinforcing is used, apply and conceal the reinforcing in accordance with the manufacturer's instructions.

E. Sand all coats as necessary after each application of joint compound or topping has dried. Leave all wallboard and treated areas uniformly smooth and ready to receive decoration after the final coat and sanding.

- 3.4 CLEANUP: Remove all misplaced and splattered joint compound from surrounding surfaces and the area of work. Leave all areas clean and dry.

END OF SECTION 09250

SECTION 09900

PAINTING

PART I: GENERAL

1.1 QUALITY ASSURANCE:

A. Include on label of containers:

- . Manufacturer's name
- . Type of paint
- . Manufacturer's stock number
- . Color
- . Instructions for application
- . Paint analysis

B. Field Quality Control:

1. Request review of first finished room, space, or item of each color scheme required by Buyer for color, texture, and workmanship.
2. When required by Buyer, paint surface not smaller than 50 ft² as project standard for selected types of paint.

1.2 SUBMITTALS:

A. Furnish test samples of materials when required by the Buyer.

B. Color Samples:

1. Submit color samples or charts from which final colors shall be selected by the Buyer.
2. Colors indicated in the paint schedule shall be matched as closely as possible.

C. Submit proposed paint and color schedule for approval, including for each item:

- . Surface to be painted
- . Type of paint
- . Special thinners required, if any
- . Color
- . Special surface preparation required

1.3 REPAIR OF DAMAGE TO EXISTING FACILITIES: All damage to paint systems of existing facilities which occur during execution of Phase IIA construction shall be repaired and recoated as specified herein.

1.4 PRODUCTS DELIVERY AND STORAGE:

- A. Delivery of Materials: Except for locally mixed custom colors, deliver materials in sealed containers with labels intact and legible.
- B. Storage of Materials:
 - 1. Paint materials and related equipment shall be stored outside of the building in the area assigned by the Buyer.
 - 2. The Contractor shall provide storage facilities adequate to protect the paint materials and equipment from inclement weather. The storage facilities shall have adequate ventilation. During cold weather, the storage facilities shall be heated to not less than the minimum recommended by the paint products manufacturer and at no time shall the temperature be below 35 degrees F.
 - 3. At the end of each work day, all paint materials shall be removed from the work area and properly stored.
 - 4. The Contractor shall obtain approval from the Buyer for all paint storage facilities used at the jobsite. All storage facilities used on the jobsite will be subject to inspection at any time by the Buyer's fire inspector.

1.5 JOB CONDITIONS:

A. Environmental Conditions:

1. Comply with manufacturer's recommendations for environmental conditions under which coatings and coating systems can be applied.
2. Do not apply finish in areas where dust is being generated.
3. Provide adequate ventilation when using flammable or toxic paint materials.

B. Protection:

1. Cover or otherwise protect surfaces not being painted.
2. Furnish fire-retardant protective coverings. Do not use flammable material for protective coverings unless special permission is obtained from the Buyer.

1.6 REFERENCE STANDARDS

- A. Rocky Flats Plant Standard No. SC-110.

PART II: PRODUCTS

2.1 MATERIALS:

- A. Materials selected for painting systems for each type of surface shall be the products of a single manufacturer.
- B. Other products not specified, but required for the job, shall be "first-line" products designed for the intended use.

2.2 COLORS: Colors of paints shall match color chips selected by the Buyer.

2.3 MIXING AND TINTING:

- A. Deliver paints ready mixed to jobsite.
- B. Accomplish job mixing and job tinting only when acceptable to the Buyer.
- C. Using tinting colors recommended by manufacturer for the specific type of finish.

PART III: EXECUTION

3.1 INSPECTION:

- A. Examine surfaces scheduled to receive paint for conditions that will adversely affect execution, permanence, or quality of work and which cannot be put into an acceptable condition through preparatory work.
- B. Do not proceed with surface preparation or coating application until conditions are suitable and approved by the Buyer.

3.2 PREPARATION OF SURFACES:

A. Gypsum Wallboard and Plaster:

- 1. Fill narrow, shallow cracks and small holes with spackling compound.
- 2. Rake deep, wide cracks, and deep holes.
 - a. Dampen with clean water.
 - b. Fill with thin layers of drywall joint cement.
- 3. Allow to dry.
- 4. Sand smooth. Do not raise nap of paper on wallboard.

B. Concrete Floors

- 1. Remove all oil, grease, and wax.
- 2. Acid etch bare concrete to ensure greater penetration and adhesion.
- 3. Neutralize acid by washing thoroughly with clean water.
- 4. Allow to dry until the moisture content of the surface is within limitations recommended by the paint manufacturer.

C. Ferrous Metals Surfaces:

- 1. Prepare surface in accordance with SSPC-SP2, Hand Tool Cleaning.

2. Feather edges of sound paint.
3. Building 891:
 - a. All interior exposed surfaces surface preparation: clean and dry, wire brush (SSPC-SP2 or SP3) failed areas.
 - b. All exterior exposed surfaces surface preparation: clean and dry, wire brush (SSPC-SP2 or SP3) failed areas.
- D. Galvanized Metal: Clean surface in accordance with SSPC-SP1, Solvent Cleaning. Dry with clean lint-free cloth.
- E. Aluminum: Clean surface in accordance with SSPC-SP1, Solvent Cleaning. Dry with clean lint-free cloth. :-
- F. Wood:
 1. Clean soiled surfaces with alcohol wash.
 2. Sand to smooth and even surface; then dust off.
 3. Apply knot sealer to all knots, pitch, and resinous sapwood before priming coat is applied.
 4. Fill nail holes, cracks, open joints, and other defects with putty or wood filler after priming coat has dried. Color to match finish color.
- G. Effluent Storage Tanks:
 1. All interior surfaces including the outside of the inner tank surface preparation: SSPC-SP10 Near White Blast.
 2. All exterior surfaces of the outer tank including the roof surface preparation: SSPC-SP6 Commercial Blast.
- H. Influent Tank Containment Area
 1. All new concrete surfaces must be allowed to cure at or above 70°F for at least 28 days prior to application of coating system.
 2. Remove all non-degraded form release agents, form oils, wax, and grease by scraping off heavy deposits and solvent cleaning or washing with a hot biodegradable alkaline detergent solution followed by

a water rinse. Scrape or grind all fins and protrusions flush with surface.

3. Abrasive brush-blast all concrete surfaces to remove laitance and solid contaminants.
4. Blasting shall be performed sufficiently close to the surface to open up surface voids, bugholes, air pockets and other substrate irregularities, but so as not to expose underlying aggregate. Dry, oil-free air must be used in the blasting operation.
5. All dust and blasting debris dust shall be removed by vacuuming. Cloths shall not be permitted for cleaning blasted surfaces because of possible lint contamination. Brushing or blowing the surface shall not be permitted, as these methods will not dislodge all particles embedded in the surface profile.

3.3 APPLICATION:

- A. Apply paint with suitable brushes, rollers, or spraying equipment.
 1. Do not exceed rate of application recommended by paint manufacturer for type of surface involved.
 2. Keep brushes, rollers, and spraying equipment clean, dry, and free from contaminants.
- B. Comply with recommendation of product manufacturer for drying time between succeeding coats.
- C. Vary slightly the color of successive coats. Tinting shall be uniform.
- D. Sand and dust between each coat to remove defects visible from a distance of 5 ft.
- E. Finish coats shall be smooth, free of brush marks, streaks, laps or pileup of paints, and skipped or missed areas.
 1. Finished metal surfaces shall be free of skips, voids, or pinholes in any coat when tested with a low-voltage detector.
 2. Doors, frames, and finished metal work or wood work shall be painted by brush or spray only. Do not roll.

F. Inspection:

1. Do not apply successive coats until each completed coat has been inspected and approved by the Buyer.
 2. Only inspected coats of paint will be considered in determining the number of coats applied.
 3. Defective or improper previous coatings shall be removed or corrected to the satisfaction of the Buyer.
- G. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.
- H. Apply primer on all work before glazing.
- I. Do not paint over fire labels on fire doors.
- J. Change colors at corner of stop where colors differ between adjoining spaces or rooms.
- K. Refinish whole wall where portion of finish has been damaged or is not acceptable.
- L. Spot coat all damage to existing facilities which occurs during construction, as specified herein, with coating systems as specified under painting systems and schedules.

3.4 CLEANING:

- A. Touch up and restore finish where damaged.
- B. Remove spilled, splashed, or splattered paint from all surfaces.
- C. Do not mar surface finish of item being cleaned.

3.5 PAINTING SYSTEMS AND SCHEDULES:

A. Painting Systems:

1. Paint System One (PS-One) for interior-exterior metals.
 - a. Prime coat for touchup. Oil-base rust-inhibitive metal primer.
 - b. Finish: Solvent-type Alkyd enamel, two coats.

2. Paint System Two (PS-Two) for gypsum wallboard.
 - a. Prime Coat: Quick-drying emulsion sealer.
 - b. Finish: Acrylic latex interior semi-gloss enamel, two coats.
3. Paint System Three (PS-Three) for masonry and porous concrete.
 - a. Prime coat for items not previously painted; vinyl emulsion masonry block filler.
 - b. Finish - Latex masonry paint, two coats.
4. Paint System Four (PS-Four) for masonry and gypsum walls in restrooms and showers.
 - a. Prime Coat - Polyvinyl acetate, high solids emulsion block filler, 6 mils dry.
 - b. Finish - Gloss, high solids, polyester-epoxy coating, 6 mils dry.
5. Paint System Five (PS-Five), Conseal (Urethane), for concrete floors in Building 891.
 - a. First Coat - 350-400 ft² /gal, thinned at four-to-one reduction.
 - b. Finish Coat - 300-400 ft² /gal, not thinned.
 - c. Temperatures above 70° F and 50% relative humidity are recommended for best drying conditions. Allow 12-15 hr between coats and 18-24 hr before allowing traffic. Follow manufacturer's direction on container.
6. Paint System Six (PS-Six) for exhaust stacks.
 - a. Prime Coat (for touchup) - Alkyd resin galvanized primer.
 - b. Finish - Aluminum, oleoresinous varnish, two coats.
7. Paint System Seven (PS-Seven) fire retardant.
 - a. Prime Coat - Apply Prime Coat per manufacturer's recommendations.
 - b. Finish Coat - Iron Clad Retardo #220 as supplied by Benjamin Moore Paints and applied at 300 sq. ft./gallon. Paint shall be UL Listed for Class A Fire Retardant.

8. Paint System Eight (PS-Eight) for all interior exposed surfaces of Building 891.
 - a. Spot Prime - Tnemec Series 37-77 Chem-Prime, 2.5-3.0 Dry Film Mils (DFM).
 - b. First Coat - Tnemec Series 111 Tufcoat, 2.0-2.5 DFM.
 - c. Second Coat - Tnemec Series 111 Tufcoat, 2.0-2.5 DFM.
 - d. Total Both Coats - 4.0-5.0 DFM.
9. Paint System Nine (PS-Nine) for all exterior exposed surfaces of Building 891.
 - a. Spot Prime - Tnemec Series 37-77 Chem-Prime, 2.5-3.0 DFM.
 - b. First Coat - Tnemec Series 23 Enduratone, 2.0-2.5 DFM.
 - c. Second Coat - Tnemec Series 23 Enduratone, 2.0-2.5 DFM.
 - d. Total Both Coats - 4.0-5.0 DFM.
10. Paint System Ten (PS-Ten) for all interior surfaces of effluent storage tanks including the outside of the inner tank.
 - a. Prime Coat - Tnemec Series 104 H.S. Epoxy, 6.0-8.0 Dry Film Mils (DFM).
 - b. Finish Coat - Tnemec Series 104 H.S. Epoxy, 6.0-8.0 DFM.
 - c. Total Both coats - 12.0-16.0 DFM.
11. Paint System Eleven (PS-Eleven) for all exterior surfaces of the outer tank of effluent storage tanks including the roof.
 - a. Prime Coat - Tnemec Series 66 Hi-Build Epoxoline, 4.0-6.0 DFM.
 - b. Finish Coat - Tnemec Series 73 Endura-Shield III, 3.0-5.0 DFM.
 - c. Total Both Coats - 7.0-11.0 DFM.
12. Paint System Twelve (PS-Twelve) for the inside of the influent tank containment areas except sump.

- a. Prime Coat - Series 104 H.S. Epoxy (spray and backroll), 8.0-10.0 DFM.
 - b. Finish Coat - Series 104 H.S. Epoxy (spray apply), 8.0-10.0 DFM.
- 13. Paint System Thirteen (PS-Thirteen) for the inside of the influent tank containment area sump, Building 891 acid and caustic containment area, and the Building 891 sump.
 - a. Horizontal Surfaces - Overkote Plus, mixed and applied per manufacturers instructions, $\frac{1}{4}$ " thickness.
 - b. Vertical Surfaces - Overkote Plus V, mixed and applied per manufacturers instructions, $\frac{1}{8}$ " thickness.
- B. Paint Schedules (all colors will be selected by the Buyer when not specified in the following schedules).
 - 1. Masonry and Concrete Walls: PS-Three.
 - 2. Doors, Door Frames, and Steel Window Frames, Exterior and Interior Sides: PS-One.
 - 3. Ladders, Ladder Cages, and Handrails: PS-One, safety yellow.
 - 4. Concrete Floors: PS-Five.
 - 5. Gypsum Wallboard Walls and Ceilings: PS-Two.
 - 6. Restroom Interior Walls: PS-Four.
 - 7. Pipe Identification: PS-One, white background with black lettering. See Division 15 for identification procedures.
 - 8. Fire Retardant: PS-Seven.
 - 9. Building 891, interior surfaces: PS-Eight.
 - 10. Building 891, exterior surfaces: PS-Nine.
 - 11. Effluent Storage Tanks, damage repair to interior surfaces: PS-Ten.
 - 12. Effluent Storage Tanks, damage repair to exterior of exterior tank: PS-Eleven.

13. Influent Tank Containment Area interior surfaces except sump: PS-Twelve.

14. Influent Containment Area sump, Building 891 acid and caustic Containment Area interior surfaces, and Building 891 sump: PS-Thirteen.

C. Items Not Required To Be Painted:

1. Roofing and roof-mounted fixtures.

2. Exterior galvanized metals.

END OF SECTION 09900

SECTION 11110

FIRE PROTECTION SYSTEMS AND FIRST AID EQUIPMENT

PART I: GENERAL

1.1 DESCRIPTION: Provide fire protection systems, complete as indicated, specified and shown on the Drawings.

A. The Contractor shall be responsible for fire protection of his own vehicles, equipment, and facilities.

1.2 QUALITY: The manufacturers' names and model number designated herein are given for the purpose of identifying the requirements of the type, general construction, materials, and operation of the specified items; and are not given with the intention of limiting the items to those of the manufacturers listed herein.

Approval of an item of another manufacturer shall be based on evidence of equal or superior construction and special features as compared to the item specified.

1.3 REFERENCE STANDARDS

A. Rocky Flats Plant Standard No. SF-100.

PART II: PRODUCTS

2.1 GENERAL: All products shall be the best of their respective kinds to the purpose intended.

2.2 FIRE PREVENTION EQUIPMENT:

A. MANUFACTURERS: Fire prevention equipment shall meet the requirements of NFPA Pamphlet No. 10. The equipment shall be as manufactured by General Fire Extinguisher Corp.; Standard Fire Equipment, Div. of Zurn Co.; Potter-Roemer; Walter Kidde and Co.; or equal.

B. FIRE EXTINGUISHERS: The following chemical fire extinguishers shall be furnished with wall brackets unless shown otherwise and installed.

<u>No. Required</u>	<u>Capacity</u>	<u>Fire Class</u>	<u>U/L Rating</u>
5	20 lbs.	A.B.C.	20 A, 80 B.C.

2.4 FIRST AID EQUIPMENT:

- A. GENERAL: One first aid equipment kit shall be furnished and installed. First aid equipment shall consist of a pre-finished, wall-mounted metal cabinet, furnished complete with standard medical supplies inside. Contents and cabinet shall be designed to meet or exceed the current requirements of OSHA General Industry Occupational Safety and Health Standards (29CFR1910).
- B. MANUFACTURER: The following manufacturer's model equal to specified unit will be acceptable: Certified First Aid; Bullard Co.; Swift Laboratories, Inc.; Johnson & Johnson; or equal.
- C. MODEL: First aid kit shall be Industrial First Aid Kit for:

1-5 employees,	Swift,	Johnson & Johnson
	Model #340116	Model "No. 10 Industrial"

Each first aid kit shall be supplied with No. 236 SB or No. 8129J snake bite kit in plastic case.

PART III: EXECUTION

- 3.1 INSTALLATION: Perform installation in accordance with the manufacturer's printed instructions and the Drawings. Fire extinguishers and first aid equipment shall be wall-mounted in accordance with the manufacturer's instructions.

END OF SECTION 11110

SECTION 15050
EQUIPMENT INSTALLATION

PART I: GENERAL

- 1.1 DESCRIPTION: This Section covers the relocation, moving, installation, alignment, grouting, leveling, and testing of the equipment as shown on the Drawings.
- 1.2 QUALITY ASSURANCE: The Contractor shall be responsible for providing all lifting, skidding, jacking, roller equipment, and labor to install the equipment.
- 1.3 SUBMITTALS: The Contractor shall furnish to the Buyer a general arrangement drawing showing necessary moving equipment which will be used in installing the equipment. The Contractor shall furnish upon request of the Buyer necessary proof that the moving equipment is in a safe operating condition and that the moving equipment is capable of handling the loads to be imposed upon it. The Contractor shall furnish the Buyer the procedure of which the equipment shall be moved.

PART II: PRODUCTS

- 2.1 MATERIALS: General: The Contractor shall furnish and install adequate leveling plates, blocks, dowels, and shims. Plates and blocks shall be steel plate stock with sheared edges. Stock may be flame cut. All shim and dowel stock shall be cold-drawn steel. Dowels shall be straight with provisions for pulling.

PART III: EXECUTION

3.1 EQUIPMENT INSTALLATION:

- A. General: Equipment, both Contractor and Buyer furnished, shall be installed and fastened as indicated on the Drawings complete with all appurtenances in place, aligned, tensioned (V-belt trans.), grouted, tested, and ready for operation.
- B. Workmanship:
 1. After moving equipment into place, the Contractor shall carefully uncrate, assemble, and install the equipment.

All work shall be performed by skilled, qualified mechanics working at their trade under experienced supervision. Equipment shall be completely assembled and all work shall be the product of first-class workmanship. Any defective or unsatisfactory installation work shall be corrected by the Contractor at the Contractor's expense.

2. Packing material shall be removed from the premises and disposed of as directed by the Buyer.

C. Lifting and handling:

1. All lifting and handling shall conform to OSHA safety practices. All handling and positioning techniques employed, including lifting, skidding, and jacking, shall be performed in a manner that will avoid subjecting the equipment to undue flexure and stress. Hooks and slings shall not be attached in any manner that can possibly result in bending, damaging, or breaking any part of the equipment. Lifting attachments shall be provided as required for lifting and setting in place and shall be approved by the Contractor.
2. Pallets, cradles, and skids shall be used wherever necessary to safely handle equipment. Lifting eyes and lugs provided on the equipment shall be used in making lifts. Any saddles, spreader beams, or other special lifting equipment required shall be provided by the Contractor.
3. Any damage to the equipment which was not present prior to installation shall be repaired by the Contractor at no additional cost to the Buyer.

D. Foundation Preparations: All caulking and dirt shall be removed from the anchor bolts and sleeves for freedom of movement. The surfaces of the foundation shall be cleaned with water before grouting. The Contractor shall make no adjustments to anchor bolts except as directed or approved by the Buyer.

E. Grouting: Grouting shall be in accordance with Section 03300 and the manufacturer's instructions using nonshrink grout.

F. Leveling: All equipment specified in room shall be precision leveled as described below and as set forth in the American Society of Mechanical Engineers B5.16 Standard. All other equipment shall be set true and level.

1. Equipment to be set true and shall be leveled both in the longitudinal and axial direction with a 36-in. carpenter's level. These levels shall be approved by the Buyer.
2. Equipment which requires precision leveling shall be leveled within 0.0005 in. in 12 in. in two directions using a four-way "Fells" precision level. The level shall be located on the work table surface or on the longitudinal ways and cross sideways as applicable. The leveling surfaces shall be clean and free of nicks and

burrs. At least three repeat readings shall be taken, without an intervening failure, rotating the level 180 degrees between readings. The Buyer shall observe the readings and will record the readings on each machine.

- G. Operational Check: All spindles, drive motors, and accessory equipment such as fans, pumps, vacuum units, etc., are to be checked for proper rotation and operation before equipment is placed into service.
- H. Touchup Paint: Surfaces of equipment installed hereunder, which are damaged or scratched during installation, shall be properly repaired and repainted to match existing paint used on the machine. The Contractor shall furnish all materials and labor required to accomplish this purpose.

END OF SECTION 15050

SECTION 15060
PIPING AND APPURTENANCES

PART I: GENERAL

1.1 DESCRIPTION: Contractor shall furnish all tools, equipment, materials and supplies including all labor required for complete installation, testing, and flushing of piping and appurtenances all as shown on the Drawings and specified herein.

1.2 SCOPE OF WORK:

A. Work Included in This Section: The Work of this Section shall include the furnishing, installation, and testing of pipe, pipe supports, fittings, specials, thrust blocks, and all required appurtenances as shown on the Drawings and as required to make the entire piping system operable.

1.3 CONTRACTOR SUBMITTALS:

A. General: Shop and Erection Drawings, together with other required information specified, shall be submitted in accordance with the requirements of Division 1 of these Specifications and the requirements specified in this Section.

B. Shop Drawings: Shop Drawings, complete with material, grade, and class for all pipe, fittings, and couplings and for all joints, coatings, and appurtenances shall be submitted. Detailed catalog and engineering data sheets shall be submitted for all components and a proposed schedule for delivering and installing the piping shall be included.

C. Erection Drawings:

1. General: Complete Erection Drawings for all buried and exposed piping shall be submitted. The drawings shall show and identify the pipe, pipe joints, fittings, couplings, joint harnesses, wall sleeves with sealant and backup thicknesses, wall castings, hangers, saddles, straps and other supports, and miscellaneous details.

2. Buried Piping: Erection Plans and Profile Drawings for all buried pipe shall show the following information:
 - a. Location, length, wall thickness, and type of joint for each pipe section and fitting to be furnished and installed;
 - b. Pipe axis station and elevation at all changes in gradient or horizontal alignment;
 - c. Within the limits of a horizontal or vertical curve, provide the station and invert or center line elevation to which the spigot end of each pipe section will be laid.
 - d. Provide the combined horizontal and vertical joint deflection at each horizontal and vertical curve or bend.
3. Exposed Piping: Erection and Elevation Drawings for all exposed piping shall show the location of the pipe, joints and couplings, critical clearances, orientation of valves, spacings of hangers and supports, and the location and size of anchor bolts.
- D. Erection Procedure: The Installation Drawings shall be supplemented with a set of written procedures for performing the field piping installation. The procedures shall cover in detail the preparation and making of the push-on, mechanical, flanged, welded, calked, flared, hard-soldered, chemically-welded and screwed joints and couplings; measures to ensure integrity of interior pipe lining and exterior protective coating at all joints and couplings; the method of backing up and sealing the annular spaces in pipe sleeves; and the installation and adjustment of pipe hangers and other supports.
- E. Protective Coating: A protective coating schedule shall be submitted, showing shop and field surface preparations, materials, methods of application, dry thicknesses and tests for defects.
- F. Testing Procedures: Procedures for testing the piping, and arrangements for obtaining and disposing of water for the tests shall be fully described. The equipment for testing

shall be itemized. Details of bulkheads, flanges, or caps for the testing of the pipe shall be included with the submittal.

1.4 PRODUCT HANDLING, DELIVERY AND STORAGE:

- A. General: Pipe shall at all times be handled with equipment designed to prevent damage to the interior or exterior coating of the pipeline.
- B. Shipping: When making shipments, all chains, cables and hold-down equipment shall be carefully padded where in contact with the pipe. For steel pipe, when the deformation is projected to exceed one percent of the diameter, each end of the pipe shall be properly braced with approved interior supports or spiders.
- C. Unloading: Unloading from the trucks shall be done with care. No pipe shall be allowed to fall from trucks. Pipe shall only be unloaded using a crane or fork lift.
- D. Gaskets: Gaskets shall be stored in containers or wrappers which will protect the gaskets from ozone and other atmospheric deterioration.

1.5 DRAWINGS: For purposes of clarity and legibility, the Drawings are essentially diagrammatic to the extent that many offsets, bends, and special fittings and exact locations are not indicated. Contractor shall carefully study the Drawings and determine for himself the extent of the Work and include in his bid all necessary bends, fittings and specials to install the Work in conformance with the Contract Documents.

1.6 REFERENCE STANDARDS

- A. Rocky Flats Plant Standard No.'s SP-211, SP-220, SP-301, and SC-107.
- B. ANSI Section B 31.3.

PART II: PRODUCTS

2.1 GENERAL:

- A. General Requirements: All pipe, fittings, couplings, and appurtenant items shall be new, free from defects or contamination, and wherever possible, shall be the standard

product of the manufacturer. They shall be furnished in pressure or thickness classes as specified or shown. Unless otherwise indicated the size shown shall be the nominal pipe diameter.

- B. Length: All pipe 48 inches and less in diameter shall be furnished in a maximum of 20 foot lengths, unless indicated otherwise.
- C. Raised Face Flanges: When carbon steel or stainless steel flanges or flanged valves with raised face will be bolted directly to flat faced FRP, plastic, or cast iron flanged fittings or valves, the raised face shall be removed or spacers approved by the valve or pipe manufacturer shall be installed to allow bearing over 100 percent of the flange area.
- D. Joints: All pipes above ground shall have screwed or flanged joints. Welded pipes will be permitted, provided that there are sufficient flanges or unions at valves and equipment to permit easy disassembling. Buried pipes shall have bell and spigot joints, unless welded, flanged or other joints are shown or specified. All bolts and nuts for flanges, joints and couplings shall be galvanized unless specified otherwise. See Table I for types of joints.
- E. Mechanical Couplings and Expansion Joints: Pipe mechanical couplings and expansion joints shall be provided at locations shown on the Drawings as a minimum requirement.
- F. Grooved Fittings: The Contractor, with the Engineer approval, may provide Victaulic, Gustin Bacon or approved equal grooved end pipe fittings and connections in lieu of screwed or flanged fittings for steel, cast iron or ductile iron pipe. Grooved joints and couplings shall conform to paragraph "Mechanical Couplings" herein.
- G. Screwed Flanges: Where pipe is furnished with screwed on flanges, the flange is to be screwed tight on the pipe until the pipe end projects beyond the face of the flange. The flange shall then be faced to give a flush finish of the pipe and flange. The flanges shall then be drilled, after attachment to the pipe, to insure bolt hole alignment.
- H. Pipe Schedule: Pipe materials shall conform to the piping schedule included within this Section.

2.2 GALVANIZED STEEL PIPE AND FITTINGS:

- A. General: Galvanized steel pipe shall be welded and seamless steel pipe conforming to ASTM A-120 standard weight or extra strong as indicated in the schedule. End finish shall be threaded.
 - 1. Threaded ends: Conform to ASTM A-120
- B. Fittings and Joints: Provide threaded fittings as indicated in the Schedule and shown on the Drawings. Unions shall be installed as required for easy disassembly at valves and equipment.
 - 1. Galvanized malleable iron threaded fittings conforming to ANSI B16.3; standard weight for standard weight pipe; extra heavy for extra strong pipe. Malleable iron shall conform to ASTM A-47; galvanizing shall conform to ASTM A-153.
 - 2. Unions shall be galvanized malleable iron threaded, ANSI Class 300 with bronze-to-iron seat.
- C. Buried Galvanized Pipe: The exterior of buried galvanized pipe shall be primed and wrapped with a cold applied tape, Type I or Type II conforming to AWWA C209.

2.3 CHLORINATED POLYVINYL CHLORIDE SCHEDULE PIPE AND FITTINGS: Pipe and fittings shall conform to the following requirements:

- A. Chlorinated Polyvinyl Chloride Pipe: Chlorinated Polyvinyl Chloride Pipe shall conform to the requirements of ASTM F441, Type IV Grade I, Schedule 80, Class 23447-B in accordance with ASTM D1784.
- B. Chlorinated Polyvinyl Chloride Pipe Fittings: Fittings shall conform to the requirements of ASTM Designation F439 for socket type fittings.
- C. Joints in CPVC Pipe and Fittings: Joints shall be the solvent-welded socket or flanged type. Flanges, where shown, shall be 150-pound, and shall be of the same material as the pipe. Solvent weld joint shall comply with ASTM F493.

D. Bolts: Bolts for use with PVC flanges shall be steel, AISI Type 303, conforming to the requirements of ASTM Designation A320-79a.

~~E. Gaskets: Gaskets for flanged joints shall be constructed of gylon. For other applications, gaskets with a Teflon envelope with high polymer chloride resin core are acceptable.~~

2.4 DOUBLE-WALLED CONTAINMENT PIPING: Containment piping shall be made from copolymer polypropylene material which conforms to ASTM D2146. The Asahi/American Proline double containment piping system or approved equal shall be used. The inside pipe nominal size shall be 2 inches and the outside pipe nominal size shall be 4 inches. Installation shall conform to "Proline Engineering Design Guide - Installation Practices" from Asahi/America or installation practices of alternate manufacturer. Transitions between containment piping and CPVC shall be made by flanges or by threaded slip joint plastic adapter or fitting. No plastic pipe shall be threaded. A 4" x 2" PP reducing tee with the tee oriented downward shall be placed at the low point of each DWPP pipe run at an accessible location. A 2" PP ball valve oriented downward shall be attached to the tee. The purpose of this assembly is for leak checks of the containment pipe.

2.7 PIPE HANGERS AND SUPPORTS: Pipe hangers, brackets, saddles, clamps, and other supports shall be adjustable type; shall have ample strength and rigidity to resist the hydraulic thrusts at changes in direction and at dead ends as well as the dead weight loads and the load carried; and shall be hot-dip galvanized, including all bolts, nuts, and threaded parts. Where not specifically identified or called out on the Drawings, computations showing adequacy of Contractor selected hangers and supports to meet these requirements shall be submitted with the Shop Drawings. Hangers and supports so identified on the Drawings does not relieve the Contractor from meeting all requirements specified herein. Wherever possible, brackets shall be used in lieu of hangers.

A. General: Hangers and supports shall include all hanging and supporting devices of metallic construction shown, specified, or required for pipe lines, apparatus, and equipment other than electrical equipment. The Contractor's working drawings, as required herein, shall show the quantity, type, design, and location of all hangers and supports required under the various Contract items. Hangers and supports shall be painted the same as required for the supported piping.

1. Where specified or shown, bolts, stud bolts, rods, yokes, and nuts of hangers and supports shall be of steel. Bolts shall not be less than 1/2-inch diameter unless otherwise called for on the Drawings.

2. Except where otherwise shown, specified, or required, hangers, supports, anchors and concrete inserts shall be the standard types as manufactured by Elcen Co., Grinnell Co., Fee and Mason Manufacturing Co., or equal meeting the requirements specified herein. Unless otherwise approved by the Buyer, all hangers, supports, and concrete inserts shall be listed with the Underwriters' Laboratory.
 3. All hangers, support stands, saddles, supports and anchors will be designed to withstand a seismic event according to RFP Standard SC-106, latest revision, for Important-Low Hazard.
- B. Design: Hangers and supports shall be adequate to maintain the pipe lines, apparatus, and equipment in proper position and alignment under all operating conditions and have springs where necessary. Hangers and supports shall be of standard design where possible, and be best suited for the service required, as approved by the Buyer. Where required, they shall be screw adjustable after installation. Supporting devices shall be designed in accordance with the best practice and shall not be unnecessarily heavy. Sufficient hangers and supports shall be installed to provide a working safety factor of not less than 4 for each hanger, assuming that the hanger is supporting 12 feet of pipe filled with water. On pipes 3 inches in diameter and larger which are covered with heating insulation, hangers and supports shall include proper pipe protection saddles. Hangers and supports shall be designed to resist all induced thrusts and lateral loads as required for seismic design.
1. Hangers and supports shall be designed and selected in accordance with MSS Standard Practices: SP-58, Pipe Hangers and Supports - Materials and Design; and SP-69, Pipe Hangers and Supports - Selection and Application.
- C. Supports for CPVC Piping: Rigid plastic piping normally shall be supported by the same type of hangers used with steel pipe, except that in no instance will C-clamp, or other point-bearing supports be allowed. Riser clamps, if required, shall be full-circumferential type only. Support spacing shall be based on the plastic pipe manufacturer's recommendations for the service conditions but not more than 5 feet on center. Flexible plastic tubing or rigid plastic

pipe operating at temperatures high enough to lower its strength, shall be supported continuously by light metallic angles or channels and special hangers.

- D. Saddle Stands: Saddle stands shall be of adjustable type. Each stand shall consist of a length of wrought pipe fitted at the base with a standard screw threaded cast iron flange and at the top with an adjustable saddle or roll. The base flange shall be bolted to the floor or foundation. Stanchions shall be of similar construction to the saddle stand, except that they shall be fitted at the top with cast iron pipe saddle supports or with pipe stanchion saddles with yokes and nuts. Where adjustable supporting devices are not required, pipe lines 3 inches in diameter and smaller may be supported on approved cast iron, malleable iron, or wrought steel hooks, hook plates, ring or ring plates.
- E. Anchors: Anchors shall be furnished and installed where specified, shown, or required for holding the pipe lines and equipment in position or alignment. Anchors shall be designed for rigid fastening to the structures, either directly or through brackets. The design of all anchors shall be subject to approval by the Buyer.
 - 1. Anchors for piping shall be of the cast iron chair type with wrought steel strap, except where anchors form an integral part of pipe fittings or where an anchor of special design is required.
- F. Inserts: Inserts for concrete shall be furnished galvanized and shall be installed in the concrete structures where required for fastening supporting devices. They shall be designed to permit the rods to be adjusted horizontally in one plane and to lock the rod nut or head automatically. Nail slots shall be provided in the exposed flanges of the insert. Inserts shall be designed to carry safely the maximum load that can be imposed by the rod which they engage.
- G. Materials: No use shall be made of wire, straps, chains, etc., for supporting piping nor shall cast expansion shields be used for anchoring bolts. Hangers and supports of metallic construction shall conform to the requirements specified herein and to the following standards:

1. Structural steel ASTM A36 and A283
2. Steel bars (grade 1022) ASTM A107
3. Steel castings (grade N-1) ASTM A27
4. Iron castings (grade 35) ASTM A42
5. Cast iron pipe fittings (class 125) ANSI B16.1
6. Malleable iron castings ASTM A47
7. Bolting materials, steel
 - a. Bolts, yokes and stud bolts ASTM A307
 - b. Nuts ASTM A563
 - c. Physical requirements
 - (1) Tensile strength 60,000-72,000 psi
 - (2) Yield strength 38,000-50,000 psi
 - (3) Elongation 27 percent maximum
 - (4) Reduction of area 35-55 percent
8. Bolting materials, silicon bronze
 - a. Bolts, stud bolts, yokes and nuts (alloy A) ASTM B98
 - b. Physical requirements:
 - (1) Tensile strength 70,000 psi minimum
 - (2) Yield strength 38,000 psi minimum
 - (3) Elongation 17 percent maximum
 - (4) Reduction of Area 45 percent maximum
9. Bolting materials, stainless steel
 - a. Bolts, stud bolts and nuts (type 316) ASTM A276

b. Physical requirements:

- | | |
|-----------------------|--------------------|
| (1) Tensile strength | 75,000 psi minimum |
| (2) Yield strength | 30,000 psi minimum |
| (3) Elongation | 35 percent maximum |
| (4) Reduction of area | 45 percent maximum |

10. Where specified or shown, bolts, stud bolts, rods, yokes and nuts of hangers and supports shall be of silicon bronze or stainless steel as specified above with dimensions, threads and sizes equivalent to those specified in steel. Where submerged in process fluids or where located in covered manholes, bolts, stud bolts, rods, yokes and nuts of hangers and supports shall be of silicon bronze, unless otherwise noted.

H. Supports for Piping: Brackets for support of piping from walls and columns shall be made of welded wrought steel and shall be designed for three maximum loads classified as follows:

- | | |
|-----------|--------------|
| 1. Light | 750 pounds |
| 2. Medium | 1,500 pounds |
| 3. Heavy | 3,000 pounds |

When medium or heavy brackets are bolted to walls, back plates of adequate size and thickness shall be furnished and installed to distribute the load against the wall. When used on concrete walls the back plates shall be cast in the concrete. Where the use of back plates is not practicable, the brackets shall be fastened to the wall in such a manner that the safe bearing strength of the wall will not be exceeded. Pipe rolls or chairs shall be of the cast iron type. Pipe rolls shall be provided with threaded rods.

I. Spacing of Hangers: Pipe support spacing requirements are indicated on the Drawings or elsewhere in these Specifications, but in no case shall the spacing of hangers exceed the following:

MAXIMUM UNSUPPORTED PIPE SPAN (FEET)

Nominal Pipe Size-Inches	Steel	PVC Max. Temp. 130°F Sch. 80
1/2	5	3.5
3/4	6	3.5
1	7	3.8
1-1/4	7	4.0
1-1/2	9	4.0
2	10	4.33
2-1/2	11	4.75
3	12	5.0
3-1/2	13	5.0
4	14	5.25
5	16	
6	17	6.0

- J. Where concentrations of valves, fittings, and equipment occur, closer spacing of supports will be required. In no case shall any total hanger load (weight of piping, insulation, and contents) exceed the following load carrying capacities for hot rolled steel rod ASTM A36-77a):

Nominal Rod Diameter - Inches	Maximum Safe Load - Pounds Max. Temp. 650°F
1/2	1,130
5/8	1,810
3/4	2,710
7/8	3,770
1	4,960
1-1/8	6,230
1-1/4	8,000
1-3/8	9,470
1-1/2	11,630

- 2.9 PIPE MATERIAL SCHEDULE: The pipe material schedule is presented as Table 1 at the end of this Section. Pipe shall be as indicated in the schedule unless otherwise shown on the Drawings or specified otherwise. Pipe material listed therein shall conform to Specifications presented in Part II of this Section.

PART III: EXECUTION

3.1 GENERAL:

- A. Care and Handling of Materials: All materials shall be carefully handled in all steps of fabrication, storing, loading, transporting, unloading, storing at the site, and installation, using the means and following the procedures submitted with the approved Shop Drawings. Pipe slings used during handling, and tie-down straps during transit shall be not less than 4-inch wide flat fiber or plastic straps.
- B. Installation:
 - 1. The different kinds of piping (buried and exposed) shall be installed in accordance with the Drawings and the procedures and methods submitted with the approved Shop and Erection Drawings. Such procedures and methods shall conform to or exceed the minimum requirement of the pipe manufacturer, and shall be as supplemented by the provisions specified herein. The interior of pipe, fittings, and couplings shall be clean and free from contamination when installed and effective means shall be taken to prevent the entrance of foreign matter during progress of the work. The types and sizes of pipes and fittings to be used shall be as specified herein and as shown on the Drawings. Where fittings are omitted from the Drawings, they shall be the same size as the piping and in all cases shall conform to the plumbing code requirements.
 - 2. All pipe shall be carefully placed and supported at the proper lines and grades and where practicable shall be sloped to permit complete drainage. Piping runs shown on the Drawings shall be followed as closely as possible, except for minor adjustments to avoid architectural and structural features. If relocations are required, they shall be approved by the Buyer.
- C. Joints: In erecting the pipe, a sufficient number of screw unions, flanged joints, or mechanical couplings shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs. Screw unions may be employed on pipelines 3 inches in diameter and under. Flanged joints or mechanical couplings shall be employed on pipe 4 inches in diameter or larger unless otherwise shown

on the Drawings. Dielectric unions must be installed at the junction of dissimilar metals.

- D. Storage and Handling: During storage, handling, and transporting, every precaution shall be taken to prevent injury to pipe. Pipe shall be handled only by means of approved hooks on ends of sections, by means of fabric slings, or other methods approved by the Buyer for the pipe used.
- E. Verification of Dimensions: All dimensions essential to the correct location of the pipe, or fit of piping at equipment and valves, or to the proper location and orientation of pipe sleeves and wall castings, or to the avoidance of obstructions or conflict with other improvements, shall be accurately determined by the Contractor prior to fabrication of the piping involved. All required changes from the nominal locations shown on the Drawings shall be made by the Contractor and shall be included as a part of the work hereunder and be approved by the Buyer.
- F. Pipe Sleeves: All piping which will pass through walls, slabs, footings, or beams shall be provided with specified pipe sleeves with annular space sealed or with wall castings. The Contractor shall provide the wall sleeves and castings for insertion in the concrete work covered in Section 03300, "Cast in Place Concrete," and shall verify their correct setting prior to concrete placement. The sleeve sealant shall be polyurethane caulking. No pipe joint will be allowed to occur in the sleeve. The seal on both ends of the sleeve shall be flush with the concrete surfaces on completion of work and drying of sealant. Caulking and sealing of wall sleeves shall conform to the following requirements and Section 07900:
 - 1. Preparation for Sealing: The annular space between the pipe and sleeve shall be cleaned of all loose particles and contamination, and shall be dry prior to sealing. Tape or other recommended protection shall be applied on the structure surfaces to preclude contamination by the sealant, and any contamination which occurs shall be removed immediately, followed by a thorough washing of the surfaces with solvent. Prepared compound not used during the application time limits designated by the manufacturer of such compound shall be discarded.

2. Application of Compound Sealant: The sealing shall be performed after any required primer has been applied and backup material placed. The work shall be performed in accordance with the submitted Erection Drawing detail and procedure, and all grooves shall be solidly filled. The application shall be made in clean, straight lines free of wrinkles, be tooled as required and finished with a convex surface just sufficient to provide the required flush surface upon drying. Work shall not be performed when the air temperature is below 50 degrees F.

3.2 BURIED PIPING:

- A. Buried Pipe Installation: Buried piping shall be laid to the grades and alignment shown on the Drawings, and all trenching, bedding, and backfilling shall conform to the applicable requirements of Division 2; other work shall conform to the following sections of AWWA Standard C600.

Section 2, "Inspection, Receiving, Handling and Storage";

Section 3.1, "Alignment and Grade";

Section 3.3, "Pipe Installation";

Section 3.4, "Joint Assembly";

Section 3.6, "Valve and Fitting Installation";

Section 3.8, "Thrust Restraint";

The foregoing requirements shall govern the work, regardless of the type of pipe installed unless a more stringent requirement is specified. When the work is not in progress, open ends of pipe and fittings shall be securely closed. The piping shall be placed when trench and weather conditions are suitable. No pipe shall be laid in water, and responsibility for the diversion of drainage and dewatering of trenches during construction, including meeting all safety and environmental requirements, shall be borne by the Contractor. All pipe in place shall be approved as to line, grade, bedding, and proper joint construction before backfilling. In all backfilling operations, the Contractor shall be responsible for preventing damage to or misalignment of the pipe.

B. Joint Installation: Installation of joints and couplings for buried piping shall conform to the following requirements:

1. Joints for pipe 4-inch diameter and over, shall comply with the supplementary requirements specified herein, and joints of all sizes shall conform to the applicable requirements specified hereinafter for aboveground piping. Care shall be taken to keep pipe in correct alignment when making joints. Friction or lever pullers or other approved means of insuring straight pulling shall be used on pipe larger than 8 inches and also on smaller sizes where damage to the end might occur. The "popping-on" of joints will not be permitted. The fitting of piping to valves, hydrants, and wall castings shall be worked out in advance of installation to ensure correct orientation of the mating ends and bedding of approach piping.
2. Silver solder shall be used for soldered joints in buried tubing.

C. Coverage: Unless otherwise shown on the Drawings, all buried piping shall have a coverage of at least 24 inches between the top of the pipe and the finished surface. Variations from the pipeline grade and alignment may be allowed to accommodate fabrication with the approval of the Buyer. All changes of grade shall require the approval of the Buyer on the Installation Drawings.

3.3 ABOVE GROUND PIPING.

A. Pipe Installation. All piping shall be installed in accordance with the Erection Drawings and the erection procedure submitted with the approved Shop or Erection Drawings. The horizontal piping shall be run parallel to the building walls and shall be level except where otherwise shown or specified; parallel lines shall be grouped on the same horizontal or vertical plane wherever possible. Vertical piping shall be plumb, and the entire piping configuration shall allow adequate clearances for convenient access for painting and preventive maintenance of valves. Piping shall clear obstructions, preserve headroom, and keep openings and passageways clear. If structural difficulties or other work prevent the running of pipes or the setting of equipment at the point indicated on the Drawings, the necessary minor deviations therefrom, as determined by the

Contractor and approved by the Buyer, will be allowed, and shall be shown on the erection drawings to be furnished. Except as otherwise shown or specified, piping installation work shall conform to the requirements of the printed or written recommendations of the manufacturer of the product involved for the given conditions, as approved.

B. Joint Installation: Installation of joints and couplings shall conform to the following requirements:

1. Joints and Couplings: Joints and Couplings shall be made in accordance with the specified requirements made part of the erection procedure submitted by the Contractor.
2. Pipe Threads: Pipe threads shall be in accordance with the requirements of ANSI B2.1, and shall be cut full and free from torn or ragged surfaces. No more than three threads on the pipe at any joint shall remain exposed after installation. Threaded joints shall be established with Teflon tape applied to the male ends only. The use of thread cement or calking of threaded joints to stop or prevent leakage will not be permitted. Sharp-toothed pipe wrenches or similar wrenches shall not be used in making up copper or brass pipe.
3. Flanged Joints: Flanged joints shall be made with gaskets centered in the joint. Bolts, studs, and nuts shall be lubricated with graphite and oil so that the nuts can be turned by hand. Care shall be taken to prevent excessive initial tension to the bolt and studs and so that the tension applied is as nearly uniform as possible. The rust preventive compound applied to the faces of flanges before shipment shall be removed before installation.
4. Tubing: Tubing which is to be soldered shall be cut square, and all burrs shall be removed. Both the inside of the fitting and the outside of the tubing shall be well cleaned with steel wool before sweating. Care shall be taken to prevent annealing of fittings or hard-drawn tubing when making connections. Joints for soldered fittings shall be made with a non-corrosive, paste flux and solid string or wire solder composed of 95.5 percent tin, 4 percent copper, and 0.5 percent silver. Soft solder or cored solder

will not be permitted. Tubing to be coupled with flared compression type fittings shall conform to the applicable provisions of the Joint Industry Conference (JIC) Standards and the recommendations of the manufacturer.

5. Mechanical Coupling Type Joints of the sleeve, grooved mechanical, split sleeve, and flanged coupling adapter types shall be made in accordance with the printed instructions of the manufacturer. The pipe ends to receive the couplings shall be finished to the outside diameter and surface finish required by the coupling manufacturer. Prior to assembly, all surfaces which will be inaccessible after installation shall be given protective coating.
6. Joint Harnesses shall be provided at sleeve type coupling joints on pressure pipelines and at all pump discharge piping. The harnesses shall be tightened just sufficiently to preclude displacement of the downstream piping under hydraulic thrust.
7. Electrical Insulation joints shall be provided at all connections between dissimilar metals and ferrous and non-ferrous pipe except where the nonferrous pipe is an electrical non-conductor. The joints shall be tested after completion to verify non-conductivity.
8. PVC Pipe Joints at fittings and couplings to valves and equipment shall be made in accordance with the manufacturer's printed instructions.

3.4 INSTALLATION OF CHLORINATED POLYVINYL CHLORIDE SCHEDULE PIPE.

- A. Fittings: Fittings for plastic pipe shall be flanged or of the socket type using the solvent weld process. Transition from plastic to steel pipe shall be by flanges or by threaded slip joint plastic adapter or fitting. No plastic pipe shall be threaded. No solvent shall be used on threaded end of plastic adapters or fittings.
- B. Anchorage: All line valves and fittings at downpipes shall be anchored to the wall in a manner to prevent stress and rotation of the pipe.
- C. Joints: Joint material for plastic pipe shall conform strictly to the printed recommendations of the pipe

manufacturer. Solvent weld connections shall be made as follows:

1. Joints shall be wiped clean and a solvent supplied by the manufacturer applied to both male and female connections.
2. Two applications of the solvent shall be made.
3. The treated surfaces shall be forced together as soon as the pipe material becomes soft or tacky and given 1/4 turn as recommended by the manufacturer.

D. Laying Pipe in Trench:

1. Bedding:

The bottom of the trench shall be covered with 6 inches of pipe embedment material (see Section 02200) compacted to 90 percent of maximum density as determined by the modified proctor testing method so as to provide the pipe with a firm and uniform bearing surface over the entire length of the pipe.

2. Laying Pipe:

- a. The Contractor shall provide the necessary mason's lines and supports to ensure installation of the pipe in accordance with the Drawings. Facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.
- b. The Buyer shall inspect all pipe and fittings before they are installed and reject any piece that is damaged by handling or defective to a degree which will materially affect the function and service of the pipe.
- c. The Contractor shall take adequate measures to prevent the intrusion of foreign materials of any kind into the pipe or fittings. At the end of each day's work, the Contractor shall adequately plug any open ends of installed pipe and fittings in order to prevent the intrusion of foreign materials.

- d. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Lay pipe with perforated side down.
- e. Pipe shall not be installed on frozen, soft, or spongy subgrade material. Pipe shall not be installed in standing water. The Contractor shall furnish all necessary equipment and labor to properly dewater the trench, as the need arises, at the Contractor's cost.
- f. Pipe which is not reasonably true in alignment or grade, or which shows any settlement after laying, shall be taken up and relaid without extra compensation to the Contractor.
- g. Pipe and fittings shall be joined in accordance with accepted industry practice.

3. Backfill:

- a. The pipe zone shall be backfilled by hand by placing embedment material simultaneously on both side of the pipe for the full width of the trench in layers 6-inches in depth. Each layer shall be compacted to a compaction of not less than 90 percent of maximum density as determined by the Modified Proctor Testing Method. Care should be taken not to damage the pipe. The pipe zone is considered to extend to 6 inches above the top of the pipe.
- b. Power, control, and instrumentation cable shall be installed in embedment material as shown on the Drawings.
- c. Class I Structural Fill to within 1 foot of surface shall be placed in horizontal layers not in excess of 6 inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor

Testing Method. Orange tape shall be placed in the Structural Fill one foot above the electrical cables.

- d. One foot of Topsoil shall be placed in horizontal layers not in excess of 6 inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method.

3.5 INSTALLATION OF PIPELINES THROUGH CONCRETE STRUCTURES:

- A. Whenever a pipeline or any material terminates or extends at or through a structural wall or sump, the Contractor shall install, in advance of pouring the concrete, the fitting or special casting required for the particular installation. Otherwise, prepare and submit Shop/Erection Drawings of other installation methods and obtain approvals in advance of commencement of work.
- B. Whenever any run of pipe is installed per approved Shop/Erection Drawings subsequent to placing of concrete, the Contractor shall accurately position the opening in the concrete for such pipelines. Unless otherwise required, all pipes penetrating fluid containing or earth supporting portions of the structure shall be ring flanged.
 - 1. Opening shall be of sufficient size to permit a perfect final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through wall to insure water tightness around openings so formed.
 - 2. The boxes or cores shall be provided with continuous keyways to hold the filling material in place and to insure a watertight joint.
 - 3. Boxes or cores shall be filled with nonshrink grout or nonshrink concrete.

- 3.6 CHANGES IN LINE AND GRADE: In the event that obstructions not shown on the Drawings are encountered during the progress of the work which will require alterations to the Drawings, the Buyer shall have the authority to change the Drawings and order the

necessary deviation from the line or grade. The Contractor shall not make any deviation from the specified line or grade without approval by the Buyer. Should any deviations in line or grade be permitted by the Buyer in order to reduce the amount of rock excavation or for other similar convenience to the Contractor, all additional costs for thrust blocks, valves, blowoff assemblies, extra pipe footage or other additional costs shall be borne by the Contractor.

3.7 IDENTIFICATION OF PIPING:

A. Definitions

1. Piping Systems - For the purpose of this section, piping system shall include fittings, valves, and piping accessories. Pipes are defined as conduits for the transport of gases and liquid.
2. Identification - Identification of piping system content (flow media) shall be a lettered legend giving the name of the contents in full (no abbreviations) as called out in the drawing legend.

B. Application

1. Location

- a. All exposed or concealed piping in finished or unfinished areas shall be identified. Underground piping shall be excepted.
- b. Identification and supplementary information legends shall be applied close to all valves, branches, changes in direction, on both sides of each floor, wall, or barrier through which the line passes, every connection to equipment, and at a maximum of 20-ft intervals on straight runs of piping.

2. Method

- a. Pipes shall have identification clearly lettered with the aid of stencils. Stenciling shall be accomplished with paint materials only; tapes and "stick-on" labels and materials are not permitted. Pipe not otherwise painted shall be painted with a white patch of sufficient length and width to receive the legends. Black

stenciling shall always be used on white patches. Legends shall be clear, sharp, and legible.

- b. Pipe or coverings less than 3/4-in. actual outside diameter shall have identification and supplementary information legends on 1/2-in.-wide aluminum tape, such as DYMO, banded in place.
3. Orientation of Legends - Attention shall be given to the orientation and visibility of identification legends. The legends shall be arranged and located so as to be easily readable by a person standing on the floor or at the normal access location to the pipe. Stenciled legends shall generally be arranged parallel with the axis of the pipe.
4. Letter height shall be as follows:

Pipe or Covering Actual Outside Diameter	Height of Lettering
3/4 in. to 1 1/2 in.	1/2 in.
Over 1 1/2 in. to 2 in.	3/4 in.
Over 2 1/2 in. to 6 in.	1 1/4 in.

- 3.8 PROTECTIVE COATINGS: Painting and coatings shall conform to the applicable requirements of Section "Painting and Protective Coatings," and the schedule submitted with the Shop and Erection-Drawings. It shall be the Contractor's responsibility to fully coordinate the protective coating requirements with the foregoing color code identification requirements to ensure compatibility of materials used.
- 3.9 TESTING: The Contractor shall perform hydrostatic, leakage, and operational tests as specified herein. The Contractor shall perform all excavation and other work required to locate and repair leaks and correct other defects which may be disclosed or develop under tests; the Contractor shall replace all coating, painting, backfill, or other permanent work removed in locating or repairing leaks and correcting defective piping. All gages and control devices connected to lines being tested must be disconnected for the duration of the test. Water shall not be used in testing air lines, chlorine lines, nitrogen lines, or other gas carrying pipes. High pressure air testing of PVC pipe

in exposed or above ground installations is not permitted. The Contractor shall furnish and install a chart type recording meter or the pressure tests. The Contractor shall submit to the Buyer before and after the test the gage and meter used so that these devices may be tested by the Buyer.

A. Testing Requirements:

1. Gravity Sewer Pipes or Other Pipelines Having Free Surface Flow Except Storm Drainage Pipelines: Vitrified clay pipe (VCP) and asbestos cement pipe (ACP) or other pipe having free surface flow shall be given a water exfiltration test as specified herein. The Contractor has the option of using a low pressure air test in lieu of the water exfiltration test. If excessive ground water is present which precludes use of the exfiltration test, the Contractor shall use either the low pressure air test or infiltration test.
2. Water Lines and Other Pressure Piping Carrying Liquids: Water lines and other pressure piping carrying liquids having bell and spigot gasketed joints shall be given a pressure and leakage test as specified herein.

Pipe Material	Test Standard
CPVC	AWWA C-900
Polypropylene	AWWA C-900
Steel Pipe	AWWA C-200

3. Pressure Pipe, Flanged or Welded Joints: PVC, FRP, steel, cast iron, ductile iron or other pipe material, with solvent welded, welded, treaded, flanged, grooved end or flexible couplings and joints shall be pressure tested as specified herein. No leakage shall be permitted.

B. Pressure Tests:

1. General: All piping, including valves, shall be field-tested at a hydrostatic pressure of 1.5 times the pipe pressure class according RFP Standard SP-301, Class B, corrected to the elevations of the test gage, with duration of two hours minimum, for each pressure test, except as otherwise requested by the Buyer. Piping conveying liquids between process tankage, not

subject to pumping, shall be tested to the maximum possible pressure that can be obtained under static conditions. Air piping shall be tested using air or nitrogen.

2. Joint Exposure: All exposed pipe, fittings, valves, hydrants, and joints shall be carefully inspected before being cast in concrete and/or during the open trench tests. All defects discovered shall be corrected by removal and replacement, as approved by the Buyer, and the work then retested to demonstrate satisfactory performance. Where practical, no concrete encasement or backfilling of pipe joints will be permitted prior to the satisfactory completion of the tests in any given section.
3. Thrust Blocks: Temporary or permanent thrust blocks shall be placed as required prior to tests, and the Contractor shall provide all necessary braces, plugs, thrust blocks, caps, flanges, and other materials to permit proper performance of the pressure testing; tests shall not be conducted until the concrete thrust blocks are capable of withstanding the loads produced.

C. Leakage Tests:

1. General: Leakage tests shall be conducted concurrently with pressure test. The lowest pressure during the leakage test shall be no less than 5 psi below the pressure used in the pressure test. No leakage shall be permitted. The duration of the test shall be not less than two hours, and measurement shall be made by means of a calibrated suction tank showing the amount of water required by the test pump to accurately maintain the specified test pressure. Tests shall be performed only in the presence of the Buyer, or, if scheduling of tests is such that the Buyer cannot attend due to conflicting commitment, tests may be performed without the Buyer's presence if the Contractor obtains written permission to do so from the Buyer prior to initiation of testing. No test report will be accepted unless proof of compliance with the foregoing requirement accompanies the test report.

3.10 FLUSHING:

- A. General: All piping shall be flushed clean of all dirt and foreign material following completion of the hydrostatic and leakage test. Air and gas piping shall be purged with air or inert gas as directed by the Buyer.
- B. Equipment and Supplies: The Contractor shall provide all equipment, and supplies for performing the work, and shall waste the water at locations or by procedures approved by the Buyer. The Contractor shall be responsible for furnishing fittings and all special pipe taps required for injecting any required sterilizing solution.

3.11 DISINFECTION: Disinfection of the chemical dilution water, plant water and potable water lines shall be performed in accordance with AWWA Standard C601.

END OF SECTION 15060

TABLE 1
PIPE MATERIAL SCHEDULE

Service	Application	Size	Pipe Material	Joint and Fittings
Influent	buried	2 in.	DWPP	butt weld/flange
	above-ground	2 in.	DWPP	butt weld/flange
	containment	2 in.	DWPP	butt weld/flange
Effluent	buried	4 in.	CPVC	solvent weld
	exposed	4 in.	CPVC	solvent weld
Transfer Pump Suction		2 in.	DWPP	butt weld/flange
Treatment	influent	2 in.	DWPP	butt weld/flange
	effluent	2 in.	CPVC	solvent weld
Potable Water	buried	2 in.	GSCW	threaded
	exposed	2 in.	GSCW	threaded and flange
Tank Overflow		4 in.	DWPP	butt weld/flange
Recirculation		2 in.	CPVC	solvent weld
Building Sump	exposed	2 in.	DWPP	butt weld/flange
Acid	influent	2 in.	CPVC	solvent weld
Caustic	influent	2 in.	CPVC	solvent weld
Acid Regenerate		2 in.	CPVC	solvent weld
Caustic Regenerate		2 in.	CPVC	solvent weld
Chemical Dilution		2 in.	CPVC	solvent weld
Spent Regenerate		2 in.	CPVC	solvent weld

KEY

CPVC - Chlorinated Polyvinyl Chloride
DWPP - Double Wall Polypropylene
GSCW - GS Coated and Wrapped

SECTION 15099

PROCESS VALVES, REGULATORS, AND MISCELLANEOUS COMPONENTS

PART I: GENERAL

1.1 DESCRIPTION: The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to furnish and install all valves and appurtenances as indicated on the Drawings, and specified herein.

1.2 SCOPE OF WORK:

A. Work Included in This Section. The Work of this Section shall include the furnishing, installation, and testing of all valves and required appurtenances as specified herein, shown on the Drawings and as required to make the entire facility operable except for those valves and appurtenances required to be provided in other Sections of these Specifications.

1.3 SUBMITTALS: Provide the following in conformance with applicable requirements:

A. Shop Drawings: Submit Shop Drawings for process valves, regulators and miscellaneous components. Shop Drawings shall be complete with bill-of-materials showing kind and class of materials, and catalog and engineering data showing compliance with the specified requirements.

B. For each type and model of valve provide:

1. Assembly instructions and spare parts list, and
2. Preventative/corrective maintenance instructions, and
3. Certificate of seat compatibility with entailed fluid exposure.

C. Erection Drawings: Erection Drawings shall include the procedures to be used in setting, supporting, and/or anchoring the valves, the fitting of line pipe to the valves for proper coupling, and for adjusting and testing all valve assemblies.

1.4 VALVE SCHEDULE: Valves shall be of the type shown on the Drawings and of the rating and construction as specified below. All valves

of the same type shall be of the same make unless otherwise approved.

PART II: PRODUCTS

2.1 CPVC VALVES:

- A. Ball valves shall be true union type with socket fittings. All parts in contact with fluid shall be CPVC, teflon, or viton. Pressure rated at 150 psi at 70°F minimum.
- B. Globe valves shall have socket fittings. Pressure rated at 150 psi at 70°F minimum. All parts in contact with fluid shall be CPVC, teflon or viton.
- C. Ball check valves shall have socket fittings and union connections, pressure rated at 150 psi at 70°F minimum and all parts in contact with fluid shall be CPVC, viton, or teflon.
- D. Swing check valves shall have flange connectors, clean out access, pressure rated at 150 psi at 70°F and all parts in contact with fluid shall be teflon or CPVC.

2.2 MOTOR ACTIVATED BALL VALVE AND OPERATOR

Electric type operators shall include the motor, operator unit gearing, limit switches, torque switches, declutch lever, auxiliary handwheel lever, reversing starter, switches, and mechanical position indicator. The valve actuator motor and all electrical enclosures shall be weatherproof, NEMA 4, as a minimum. The power gearing shall consist of helical gears of heat-treated steel, and worm gearing of hardened alloy steel. All power gearing shall be grease lubricated with high speed parts on antifriction bearings.

- A. Motors shall be totally enclosed non-ventilated (TENV) construction with NEMA Class B insulation with a maximum continuous temperature rating of 120°C. The motor shall be of sufficient size to open or close a valve against the maximum specified differential pressure when voltage to the motor is $\pm 10\%$ of nominal voltage. Electrical service to the motor shall be single phase, 60 HZ, 120 VAC. The motor shall be prelubricated and all bearings shall be of the anti-friction type. Motor rating shall be 30 minute duty.
- B. Limit Switches and their gearing shall be an integral part of the valve operator. The limit switch compartment shall be totally enclosed and equipped with a heater and thermostat to

prevent build up of moisture and contamination. Switches shall be SPDT and rated 10A at 120VAC. The actuating point shall be adjustable at any point of valve travel between fully open and fully closed.

C. Manufacturer. Electric valve actuators shall be as manufactured by Limitorque, Electrodyne by Foxboro-Jordan or Buyer approved equal.

D. Valve. The valve shall be ball valve type as manufactured by Jamesbury, Worcester, or Buyer approved equal.

2.3 BACKFLOW PREVENTION VALVE SYSTEM

Backflow prevention valve system shall be rated 175 psi working pressure at 140°F. The units shall be constructed with a screwed bronze body, and stainless steel seats, shafts and bolts. They shall be as manufactured by Watts, Model No. 9095QT, Febco, Model No. 825Y-BV, or Buyer-approved equal.

2.4 PRESSURE RATING: All process valves shall be rated for a working pressure equal to or more than the pressure rating of the connecting piping unless specifically shown otherwise on the Drawings or specified in other Sections of these Specifications.

2.5 IMMERSION HEATERS FOR TANKS 201, 202, 203 and 204: Immersion heaters shall be through-the-side immersion heaters rated at 30KW, 4608V-3ph-60HZ utilizing standard 5 inch diameter 150# class flange. Heating elements shall be made of copper for Tanks 201, 202 and 203, and 316 stainless steel for Tank 204. Immersion heaters shall be as manufactured by Chromalox Model TM-6305 E4 for Tanks 201, 202 and 203, and Model TMS-6305 E4 for Tank 204, or Buyer approved equal.

PART III: EXECUTION

3.1 INSTALLATION: Installation shall be in conformance with Sections 15060 and 15400 and the following requirements:

A. Valves and Valve Boxes shall be set in true alignment and grade in accordance with the procedures submitted with the shop and erection drawings, and the valves mounted as shown. All adjustments and operating settings of valves and appurtenances shall be made in accordance with procedures and detailed instructions furnished with the Erection Drawings.

- B. Buried Valves shall be firmly supported in place by the foundations to preclude strain on the pipe connections. The valve boxes shall be checked for centering plumb over the wrench nut to ensure that the box cover is flush with the finish grade. Earth backfill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to undisturbed trench face if less than 4 feet. Valves shall have their interiors cleaned of all foreign matter before installation. The valves shall be inspected in opened and closed positions to ensure that all parts are in working condition.
- C. Aboveground Valves shall be rigidly held in place using supports and hangers as shown on the drawings and as specified. The stem orientation of valves in elevated piping shall be as approved by the Buyer for accessibility, but no valve shall have stem in the downward direction. Saddle type valve supports shall be provided for all valves in vaults. Supports shall be of rugged construction providing at least 120 degrees under-support for the valve body, shall be constructed of steel as specified in Division 5, and shall be anchored to the foundations using galvanized anchor bolts.

3.2 TESTS:

- A. Field Tests: Test all valves and appurtenances for proper operating adjustments and settings and for freedom from vibration, binding, scraping, and other defects. The adequacy of all pipe hangers and supports and valve supports to meet specified requirements shall be verified. All defects found shall be corrected as approved.

3.3 COORDINATION WITH INSTRUMENTATION: It shall be the responsibility of the Contractor to coordinate with Division 17 regarding the requirements of control valves.

3.4 CLEANING: All valves and appurtenances shall be flushed clean of all foreign matter together with the piping as specified in other sections.

3.5 LABELING: After the painting, if required, of process piping is complete, the Contractor shall stencil the tag numbers of all valves numbered on the P and ID Drawings, on the pipe adjacent to the valve for pipe 2 inches and over. Characters shall be one inch high minimum and shall be oriented to be visible from the valve operating position. When the valve has extended operator shaft or chain operator, the number shall be placed both at the operating

position and at the valve if the valve cannot be seen from the operating position. The latter requirement does not apply if the valve is buried. Valves in pipes under 2 inches shall have characters as large as the pipe will permit, or at the Buyer's option, on an adjacent surface. Characters shall be preferably white, however, if this would not provide sufficient contrast to the pipe, the Buyer may select another color. Paint used shall be of the same type and quality as used for painting the pipe.

END OF SECTION 15099

15099-5

SECTION 15140

PUMPS

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15060, Piping
- B. Section 15099, Process Valves

1.2 SCOPE OF WORK

- A. The work in this section shall include the furnishing, installation, and testing of pumps and motors as shown on the Drawings.

1.3 SUBMITTALS

The Contractor shall provide the following in conformance with applicable requirements in Division 1:

- A. Installation, maintenance, and operating instructions;
- B. Pump curves;
- C. Specifications of materials in contact with fluids being pumped.

PART II: PRODUCTS

2.1 SUMP PUMP

Building 891 sump pump (P107 & P108) and the influent tank containment sump pump (P109) shall be ABS brand model SEVH-4W or Buyer approved equal 4/10 HP, 9" wide, 40 GPM at 20 foot head, 1 1/2" NPT discharge, 230 volt, single phase.

Building 891 sump pumps shall be accompanied by vendor supplied control panel and four mercury float switches. The control panel shall be suitable for wall mounting and contain the following:

- three float control: lead pump start, lag pump start, stop;
- fourth float - high high alarm;
- alternator circuit which changes the lead pump after each use;
- motor circuit protection.

The influent tank containment sump pump shall be operated manually.

2.2 TRANSFER PUMPS

Transfer pumps (P301, P302) shall be Aurora brand model 321, or approved equal, frame 56, 1/2 HP, 1" NPT discharge, 4" case bore, 33 GPM at 30 foot head, 480 volt, 3 phase.

2.3 NEUTRALIZED EFFLUENT PUMP

The neutralization effluent pump (P210) shall be a March brand model TE-7R-MD, or approved equal, 1 hp, 1" NPT discharge, 50 gpm at 13 foot head, 230 volt, 60 hz single phase.

PART III: EXECUTION

3.1 GENERAL

Contractor shall coordinate pump installation with other trades including concrete work, process piping, electrical, and instrumentation. Installation shall comply with Section 15050 "Equipment Installation."

3.2 INSTALLATION

Pumps shall be mounted and plumbed, and electrical connections made as prescribed by the pump manufacturers.

3.3 TESTING

Pumps performance shall be tested as recommended by the manufacturers.

END OF SECTION 15140

SECTION 15150

NEUTRALIZATION AND CHEMICAL STORAGE TANKS

PART I: GENERAL

- 1.1 The storage tanks shall be made of fiberglass reinforced plastic (FRP). The tanks shall be fabricated per ASTM D-3299 (standard specification for filament-wound glass-fiber reinforced polyester chemical-resistant tanks).
- 1.2 Saddles will be provided on each horizontal tank.

PART II: TANK FABRICATION REQUIREMENTS

- 2.1 Tank fabrication and materials shall comply with ASTM D-3299, latest revision.
- 2.2 Fabrication tolerances for tanks shall be as specified in ASTM D-3299, latest revision.
- 2.3 Flanges shall be 150 pound flat face conforming to ANSI B16.5.
- 2.4 Orientation of flange bolt holes shall straddle vertical and horizontal centerlines.
- 2.5 External attachments shall be of the same material as the tank to which they are attached.
- 2.6 A nameplate shall be attached to each tank. The following information, in addition to that required by ASTM D-3299, shall be stamped in 3/16-inch-high letters on the name plate:
 - A. Capacity in gallons.
 - B. Design thickness.
 - C. Type of fiberglass.
 - D. Rocky Flats purchase order number.
 - E. Rocky Flats specification number.
 - F. Rocky Flats equipment name and item number.

PART III: TANK DESIGN REQUIREMENTS

3.1 Acid Storage Tank

- A. 2,500 gallon minimum capacity, not to exceed 2,600 gallons, with maximum length of 15 feet.

- B. Acid - 20% Be hydrochloric.
- C. Horizontal with dished heads.
- D. Saddle stands with 10-inch distance between floor and bottom of tank.
- E. 2-inch flanged drain nozzle (flush) head mounted.
- F. 18" flanged top-mounted manway.
- G. Three 2-inch top mounted flanged nozzles for inlet, level element probe, and vent connection.
- H. One 2-inch top mounted (flush) nozzle for overflow. 2-inch CPVC pipe should extend inside tank to within 2 inches of the bottom.

3.2 Caustic Storage Tank

- A. 1,250 gallon minimum capacity, not to exceed 1,350 gallons, with maximum length of 9 feet.
- B. Caustic - 50 weight percent sodium hydroxide.
- C. Horizontal tank with dished heads.
- D. Saddle stands with 10-inch distance between floor and bottom of tank.
- E. 2-inch flanged drain nozzle (flush) head mounted.
- F. 18" flanged top-mounted manway.
- G. Three 2-inch top-mounted flanged nozzles for inlet, level element probe, and vent connection.
- H. 2-inch flanged overflow nozzle (flush) head mounted.

3.3 Neutralization Tank

- A. 5,000 gallon capacity with maximum diameter of 8 feet and a maximum height of 16 feet.
- B. Spent ion exchange regenerate solutions, approximately pH 2 to 14.
- C. Vertical, flat bottom, double walled tank with cover.

- D. Top mounted center shaft mixer. Mixer shall be Lightnin Type 14Q2 - 2Hp 125 RPM, mounted on an adequate support structure with flange mounting.
 - E. 4-inch flanged sidewall mounted (flush) drain nozzle at approximately 6-inches from bottom of tank.
 - F. One 2-inch top mounted (flush) flanged nozzle for level element probe.
 - G. One 2-inch top-mounted (flush) flanged nozzle for pH probe.
 - H. One 18-inch flanged top-mounted manway.
 - I. One 2-inch top-mounted (flush) flanged nozzle for spent regenerate.
 - J. One 2-inch top-mounted (flush) flanged nozzle for dilute caustic.
 - K. One 2-inch top-mounted (flush) flanged nozzle for dilute acid.
 - L. One 2-inch top-mounted (flush) flanged nozzle for vent.
 - M. Neutralization chemicals shall be 4-8 weight percent hydrochloric acid and 4-8 weight percent sodium hydroxide.
 - N. One 2-inch side mounted (flush) nozzle for overflow.
- 3.4 Tanks and bolting attachment shall be designed to resist stresses created by a 25 percent maximum seismic load when the tank is full.
- 3.5 All tanks shall be leak tested by filling with water for 24 hours. No leaks will be tolerated.

PART IV: SUBMITTAL REQUIREMENTS

4.1 GENERAL REQUIREMENTS:

The Contractor shall furnish the following approval and final data. Each document shall be clearly identified with the Buyer's purchase order number and project number.

4.2 APPROVAL DATA:

- A. Three complete sets of design calculations and fabrication drawings shall be submitted and one set returned approved by the Buyer before purchase of material or fabrication. The Buyer's approval shall not relieve the Contractor of this responsibility for the design, drawing accuracy, quality of workmanship, and conformance to this Specification.
- B. Three copies of shop qualifications to include: shop equipment, resin mixing technique, qualifications for fabrication technique (i.e., hand lay-up or filament wound), and typical shop records used during fabrication and testing.

4.3 FINAL DATA:

- A. The following listed data shall be furnished as five separate booklets, and any pertinent data not listed shall also be included:
 - Five complete sets of "as-built" fabrication drawings, calculations and the following data sheets.

FABRICATOR'S DATA-REPORT FOR RTP VESSELS

1) Fabricated by _____
(Name and Address of Fabricator)

2) Fabricated for _____
(Name and Address of Purchaser)

3) Type of Equipment _____
(Storage Vessel, Reactor, Scrubber, Duct, Stack, etc.)

4) Size: Dia. _____, Length _____
(sidewall)

5) Laminate Classification _____
(Appendix M-1 or M-1A)

6) Resin: _____, Curing System _____

7) Installation: Vertical (), Horizontal ()

8) Heads Type: (Flat, Klanged and dished, hemispherical, other)
 Top _____ Bottom _____

9) Supports:
 Flat Base _____ Skirt _____ Lugs _____ Legs _____ Other _____
(Number) (Number) (Describe)
 Attached _____
(Where and How)
 Remarks: _____

10) Head to Shell Attachment:	Top	Bottom
Continuous Laminate	()	()
Butt and Strap	()	()
Bell and Spigot	()	()
Flanged	()	()

11) Working Press. (max. allowable) _____ psi, at max. temp. _____

12) Glass Content (pct.)

Shell _____

Bottom Head _____ (Not required for flat bottom)

13) Thickness

Shell _____ (above bottom head attachment and/or reinforcement)

Bottom Head _____

Top Head _____

14) Manways:

No. _____ Size _____ Location _____
Top head: Shell—top 1/2
 bot 1/2

15) Inspection Nozzles (blanked)

No. _____ Size _____ Location _____

16) Process Nozzles

(a) Top Head:

No. _____	Size _____	Location _____
_____	_____	_____
_____	_____	_____
_____	_____	_____

(b) Shell:

No. _____	Size _____	Location _____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

(c) No.	Size	Location

17) Hydrostatic Test Pressure _____ psi

18) Remarks: _____

19) Materials Acceptance:			
Lot No.	Batch No.	Inspected & Approved by	Date of Approval

Surf Mat
Chop Mat
Woven Roving
Fil. Roving

20) Resin Identification _____
Verified by _____ date _____

21) Resin Acceptance: _____

	Lot No	Tested by-date	Approved Inspection-Date
Viscosity			
Sp. G.			
Gel			

	Identity	Tested by-date	Accepted by-date
Catalyst			
Promoter			
Accelerator			

Remarks: _____

23) Date _____ Insp. _____
 Acceptance Signature and Printed Name

RESIN LOG SHEET

Equip. Being Fabricated _____ Resin Mfr. _____
Customer _____ Address _____
P.O. No. _____ Q.C. File No. _____ Telephone No. _____
QC Contact _____

[illegible]

15150~7

TABLE 2
LOG SHEET RESIN GEL TIME

Equip. Being Fabricated _____ Curing Agent _____
 Customer _____ Manufacturer _____
 P.O. No. _____ Q.C. File No. _____ QC Contact _____

Date	Lot No.	Batch* No.	25°C Gel (Min.)	Tested by
			Spec. 20 min. \pm 5 min.	

Remarks:

*Batch or container number.

TABLE 3
REINFORCEMENT LOG SHEET

Equip. Being Fabricated _____ Mat—FG () Synthetic ()
 Customer _____ Manufacturer _____
 P.O. No. _____ Q.C. File No. _____ QC Contact _____

SURFACING MAT
M-3 Sections A & F

DATE	LOT NO.*	ROLL WIDTH	THICKNESS	WEIGHT	TENSILE STRENGTH	INSPECTED BY
		VISUAL INSPECTION—REMARKS:				

*Lot, Batch, or other label identity.

TABLE 4

REINFORCEMENT LOG SHEET

Equip. Being Fabricated _____ Mat Weight _____
 Customer _____ Manufacturer _____
 P.O. No. _____ Q.C. File No. _____ QC Contact _____

CHOPPED STRAND MAT
M-3 Section B

DATE	LOT NO.*	WIDTH	WEIGHT	BINDER SOLUBILITY	INSPECTED BY
		VISUAL INSPECTION—REMARKS:			

*Lot, Batch, or other label identity.

TABLE 5

REINFORCEMENT LOG SHEET

Equip. Being Fabricated _____ Roving: Spray-up () Wind ()
 Customer _____ Manufacturer _____
 P.O. No. _____ Q.C. File No. _____ QC Contact _____

SPRAY-UP OR WINDING ROVING
M-3 Sections C & E

DATE	LOT NO.*	ROVING YIELD	INSPECTED BY
		VISUAL INSPECTION—REMARKS:	

*Lot, batch, or other label identity.

TABLE 6

REINFORCEMENT LOG SHEET

Equip. Being Fabricated _____ Roving Weight _____
 Customer _____ Manufacturer _____
 P.O. No. _____ Q.C. File No. _____ QC Contact _____

WOVEN ROVING
M-3 Section D

DATE	LOT NO.*	WIDTH	WEIGHT	WEAVE CONSTRUCTION	INSPECTED BY
		VISUAL INSPECTION—REMARKS:			

Lot, batch, or other label identity.

TABLE 7

FABRICATION LOG SHEET

Equip. Being Fabricated _____

Customer _____

P.O. No. _____ QC File No. _____

DATE	INSPECTION	INSPECTED BY
	A. Documents on File	
	Basic Data ()	
	Material Specs ()	
	Approved Drawings ()	
	B. Verification of Materials Specified	
	Resin ()	
	Curing Agents ()	
	Reinforcements ()	
	Thixotropic Agent ()	
	Resin Cements (putties) ()	
	Fillers and/or Fire Retardants ()	
	Pigments ()	
	Paraffinated Top Coat ()	
	C. Laminate	
	Hand Lay-up	
	Ply Sequence ()	
	Filament Wound	
	Liner ()	
	Angle of Wind ()	
	Number of Cycles ()	
	Intersperse ()	
	D. Assembly	
	Lay-out ()	
	Fit-up ()	
	Joint Preparation ()	
	Gap Filling ()	
	Bonding ()	
	Final Inspection ()	

TABLE 8
FINAL INSRECTION SHEET

Equip. Being Fabricated _____

Customer _____

P.O. No. _____ QC File No. _____

DATE	INSPECTION	INSPECTED BY
_____	Barcol Hardness ()	_____
_____	Acetone Test (sec. bonds) ()	_____
_____	Laminate Quality ()	_____
_____	Visual insp.-per Table 4 of M-1 ()	_____
_____	Visual insp. of Cut Out cross sec. ()	_____
_____	Burn out-Resin Content ()	_____
_____	-Glass Content ()	_____
_____	Secondary Bond Quality ()	_____
_____	Dimensional Locations ()	_____
_____	Alignment Tolerances ()	_____
_____	Hydrostatic Test ()	_____

SECTION 15180

PIPE INSULATION

PART I: GENERAL

- 1.1 DESCRIPTION: This section covers the furnishing and installing of the insulation on exposed and buried above freezing zone [approximately five (5) feet of cover] transfer piping and domestic cold water piping as indicated on the Drawings. The installed insulation shall completely insulate the systems as required for freeze protection.
- 1.2 SUBMITTALS: Submit Shop Drawings, catalog data, and descriptive literature of all items.
- 1.3 STORAGE AND HANDLING: All materials to be used shall be protected from the elements during storage. Materials shall be stored and handled in a manner so as to prevent damage. Any insulation exposed to moisture prior to installation shall be rejected by the Buyer.
- 1.4 REFERENCE STANDARDS
 - A. Rocky Flats Plant Standard No. SP-401.
- 1.5 No asbestos pipe insulation is allowed.

PART II: PRODUCTS

- 2.1 General: Insulation shall be suitable for outdoor use for temperatures ranging from -20 degrees F to 400 degrees F. The insulation shall have ratings not to exceed flame spread of 25, smoke development of 50, and fuel contribution of 50 when tested to American Society for Testing and Materials (ASTM) E-84 and Underwriters' Laboratories, Inc. (UL), 723.
- 2.2 Closed-Cell Insulation: Expanded closed-cell insulation shall be flexible, elastomeric thermal insulation, 4 PCF density, supplied in tubular form 1 1/2" thick for piping and flat sheets 2" thick for influent tanks. Thermal conductivity shall not exceed $K=0.25 \text{ BTU} \times \text{in./hr.} \times \text{ft}^2 \times \text{degrees F}$ at 0 degrees F mean temperature per ASTM C177, water vapor permeability less than 0.17 perms per ASTM E 96 procedure E, water absorption less than 6% by weight per ASTM D 1056. The closed cell insulation shall be as manufactured by Armstrong Armaflex, Thermazip, Certain Teed or approved equal.

- 2.3 Jacketing: Fitting coves and jacketing for piping shall be aluminum alloy 3003-H14 per ASTM B209, thickness 0.025 in., fabricated to exact dimensions. Structural members, if used for reinforcement shall be alloy 6061-T. Clamps for underground applications shall be stainless steel and underground gasket material shall be neoprene.
- 2.4 Non-Shrinking Caulk: Suitable for outside application with temperature range from -30 degrees F to 100 degrees F.

PART III: EXECUTION

3.1 GENERAL:

- A. All necessary testing on piping shall be completed prior to installation of insulation.
- B. Install all materials according to the approved recommendations of the manufacturer and conforming to the Drawings and Specifications.
- C. All insulation shall be installed over clean, dry surfaces.
- D. Work shall be done by a Contractor who is thoroughly familiar with insulation applications. Contractor shall exercise extreme care while backfilling insulated piping to protect jacket.

3.2 ABOVE GROUND INSULATION: Pipe insulation shall be 1 1/2". Molded pipe insulation shall be slit lengthwise and snapped over clean and dry piping already connected and/or slipped onto piping before it is connected. Fitting insulation shall be premolded or fabricated from 1 1/2" thick miter-cut tubular form or from 1 1/2" thick sheet insulation held in place with 16 gauge wire. In all cases, butt joints and seams shall be sealed with manufacturer recommended contact adhesive. Both surfaces to be joined shall be coated with adhesive.

3.3 APPLICATION OF JACKET: Aluminum tubing for piping and/or fittings shall be joined in the field and sealed vapor tight with non-shrinking caulks. Structural reinforcement, when used, shall be attached to jacket with aluminum fasteners.

3.4 BELOW GROUND INSULATION AND JACKET: Pipe insulation and jacket shall be applied as above except that the jacket shall have a bottom aluminum boot completely sealed around the pipe to prevent

any moisture intrusion. Each boot shall be secured to the pipe with a stainless steel clamp isolated from the aluminum jacket with a neoprene gasket. An identical gasket shall be provided between the pipe and aluminum boot to isolate dissimilar metals.

END OF SECTION 15180

SECTION 15221
MECHANICAL MIXER

PART I - GENERAL

- 1.1 DESCRIPTION. Provide and install a direct drive propeller mixer for the neutralization tank as specified herein and shown on the Drawings. The equipment furnished with the mixer shall include center drive assembly with couplings, rotating shaft, propeller and all necessary appurtenances as recommended by the manufacturer.
- 1.2 QUALITY. All equipment furnished under this section shall be (1) of a design and manufacture by Lightnin or equal; or (2) demonstrated to the satisfaction of the Buyer that the quality is equal to the specific equipment named herein.
- 1.3 SUBMITTALS.
 - A. Shop drawings showing bill of material items of specified equipment, assembly, fabrication, installed dimensions, location and size of all connections, detailed specifications, and performance data shall be submitted. Additional data required, but not limited to, are:
 1. Propeller size, type, and pitch.
 2. Shaft size, material, and length.
 3. Size, make, and type of electric motor.
 4. Motor horsepower draw.
 5. Total overall weight of mixer assembly.
 6. Maximum horsepower requirement of the mixer.
 7. Details of the mixer.
 8. Details of the drive motor.
 9. Maximum loads produced by the unit operated under maximum water depth.
 10. Critical speed.
 - B. Operating and instruction manuals shall include standard publications on all major items furnished, parts lists with specification packets on the entire unit, complete final

wiring connection and schematic diagrams, and installation diagrams.

PART II - PRODUCTS

2.1 MIXER SCHEDULE. Provide one mixer for the neutralization tank.

Purpose	Neutralization Mix
Process Fluid	Spent Regenerant, pH 2 to 14
Mixing Basin:	
Diameter	8'
Fluid Depth	13'
Fluid Volume (gals)	5,000
Motor	
Horsepower	2 Hp
Speed	1,750 rpm
Agitator Speed	125 rpm
Lightnin Model	14Q2
Wetted Parts	
Shaft	shall be coated with a material which will be durable and resist 10% HCl.
Propeller and Appurtenances	
Mounting	flange

2.2 MATERIALS.

- A. Mixer Shaft. The propeller shaft shall operate at no more than 65 percent of shaft critical speed unless the unit is fully stabilized and dynamically balanced in which case the shaft may rotate at speeds up to 80 percent of the shaft critical speeds.
- B. Propellers. Propellers shall be attached to the shaft with set screws. At the manufacturers option, dual or single propellers shall be provided, the selection of which shall be justified in the required submittal.
- C. The mixer shall not draw more than 80 to 85 percent of nameplate motor horsepower.
- D. Mixer propeller placement shall be as recommended by the manufacturer for effective mixing without baffles in tank.

- E. Speed Reducer. The speed reducer shall be directly connected through a flexible coupling to the electric drive motor. The speed reducer shall be capable of 24 hr/day continuous operation. The mechanical rating of the speed reducer shall be at least 1.5 times the motor nameplate horsepower at full speed. All drives shall be parallel shaft, single or double reduction helical gear combination.
 - F. Construction Materials. The mixer wetted parts shall be of the materials indicated in the schedule. Wetted parts include shaft impeller, stabilizers, and appurtenances.
 - G. Mounting. Provide mount as indicated in the schedule.
 - H. Painting. Carbon steel components subject to splash or submergence shall be coated as specified in Section 0990.
- 2.3 MOTOR. Electric motor shall be constant speed, totally enclosed motor, fan cooled. Motor shall be 460 volt, 3 phase 60 hertz. Motor terminal boxes shall be gasketed watertight.

PART III - EXECUTION

3.1 INSTALLATION

- A. Equipment Inspection. Examine the equipment delivered to the site and determine that it is in conformance with the approved shop drawings, and that it is new and in good condition.

- 3.2 START-UP. The Contractor shall perform start-up of the equipment and demonstrate the required performance to the satisfaction of the Buyer.

END OF SECTION 15221

SECTION 16010--ELECTRICAL

PART 1: GENERAL

1.1 GENERAL REQUIREMENTS

- A. The installation of all electrical equipment shall comply, as a minimum requirement, with the applicable rules of the latest additions of the National Electrical Code (NEC) and the National Electrical Safety Code. Where code requirements are exceeded on the drawings or in this specification, drawings and specifications shall apply. Where a conflict exists between code requirements and drawings and specifications, the most stringent requirements shall apply.
- B. The contract drawings indicate the extent and general arrangement of the conduit, wiring, and equipment installation. Exact field mounting, routing, and installation details, where not explicitly shown on the drawings and not indicated in these specifications, shall be determined by the Contractor. The Contractor shall execute the work in a neat journeyman-like manner using approved materials and methods and at no additional cost to the Buyer.
- C. No portion of the permanent wiring and electrical system shall be utilized until all final inspections have been performed.

PART II: PRODUCTS

2.1 MATERIALS

- A. All electrical materials shall be new and as listed by the Underwriter's Laboratories, Inc., (UL) except as otherwise specified in these specifications.
- B. All electrical equipment shall be rated and suitable for use and operation at an altitude of 6000 feet.

PART III: EXECUTION

3.1 ELECTRICAL SAFETY

- A. The Contractor shall take all necessary precautions in the performance of work to safeguard persons from an electrical hazard. The Contractor shall comply with all applicable safety regulations and requirements. The Contractor shall submit an electrical safety program and implementation plan as part of his overall safety program submittal as required in the general provisions of this specification.
- B. Electrical safety regulations referenced in this specification encompass the minimum provisions considered necessary for the safety of personnel. In addition to the Secretary of Labor's "Safety and Health Regulations for Construction," 29 CFR 1910, listed in the

general provisions of this specification; the Contractor shall comply with the American Public Power Association "Safety Manual for an Electrical Utility" and the "National Electrical Safety Code" (NESC) ANSI-C2 for work on electrical systems over 600 VAC. The Contractor shall comply with the "National Electrical Code" (NEC), the NESC, and the Rocky Flats Plant Health, Safety, and Environment (HS&E) Manual. In case of conflict, the most stringent requirements shall apply.

- C. The Contractor shall not perform work on energized electrical systems without prior approval from the Buyer or his designated representative. The Contractor shall submit for approval a written, detailed plan of operations for work to be performed on energized electrical systems.

3.2 REPAIR OF EXISTING WORK: The work shall be carefully laid out in advance. Where any penetrations are necessary for the installation, support, or anchorage of conduits, raceways, or other electrical work, this work shall be accomplished with a minimum of disturbance to existing structures and systems. Any damage or loss incurred to buildings, piping, or equipment shall be repaired and/or replaced at no expense to the Buyer.

3.3 INSPECTION AND ELECTRICAL TESTS

- A. The Contractor shall, under the supervision of the Buyer or his designated representative, provide all required test equipment and materials and test all wiring and electrical connections for continuity and grounds. Upon direction by the Buyer, the Contractor shall demonstrate by Megger test, the insulation resistance of any circuit or group of circuits. Where such insulation tests indicate faulty insulation, the Contractor shall replace the faulty material with new material and demonstrate by Megger test that the new material is sound.
- B. All ground rods or grounding terminals shall be tested and recorded in accordance with these specifications using a double scale (0-30 and 0-300 ohms) Null Earth Tester.
- C. All 480 VAC power circuits shall be Megger tested just prior to being placed in operation.
- D. The Contractor shall provide all test equipment and materials and perform appropriate high potential tests on all power cables rated 2.4kV and above.
- E. After the interior wiring systems are completed and at such time as the Buyer may direct, the Contractor shall conduct an operational test on wiring systems and equipment. Equipment shall be demonstrated to operate in accordance with the functional intent of the design and the requirements of these specifications.

END OF SECTION

DIVISION 16050
BASIC MATERIALS AND METHODS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. The installation shall comply, as a minimum requirement, with the applicable rules of the latest edition of the National Electrical Code (NEC), except where code requirements are exceeded as specified on the drawings or in this specification.
- B. All electrical materials shall be new and as listed by the Underwriters' Laboratories, Inc. (UL), except as otherwise specified herein.
- C. All lamps shall be Government-furnished but installed by the Contractor.
- D. The contract drawings indicate the extent and general arrangement of the conduit and wiring systems.
- E. No portion of the permanent wiring system for the building shall be utilized until the final inspection is performed.

1.2 REFERENCE STANDARDS

- A. Rocky Flats Plant Standard No.'s. SE-103, SE-104, SE-112, SE-114, and SC-107.

PART II: PRODUCTS

2.1 PRODUCT REQUIREMENTS: All electrical equipment shall be suitable for operation at an altitude of 6,000 ft.

2.2 CIRCUIT BREAKERS: Circuit breakers for 120/208 V and 480 V shall be suitable for use in the panelboard or motor control center (MCC) in which they are installed. Circuit breaker shall be new and UL listed.

2.3 CONDUCTORS

- A. General - All conductors shall be sized according to the American wire gage (AWG) standard. All conductors shall be copper. All conductors shall be stranded. Minimum size shall be No. 14. Wire sizes No. 14-1 shall be sized at a conductor temperature rating of 60°C. Wire sizes No. 1/0 and larger shall be sized at a conductor temperature rating of 75°C.

- B. Conductors 250 MCM and larger shall be stranded, 600 volts, and Type RHW.
- C. Conductors smaller than 250 MCM shall be stranded, 600 volt and Type THW, type THWN, or Type XHHW.
- D. High Voltage Cables shall be 15 KV, Type MV-90, 133 percent insulation level, rated 90° centigrade continuous, 130° centigrade emergency overload and 250° centigrade short circuit. The cable shall be delivered reeled and in one continuous length with ends sealed. The cable shall be stranded copper with strand screen, ethylene-propylene rubber insulation, insulation screen, copper shield and polyvinyl chloride jacket. The cable shall be Okonite "Okoguard Okoseal", Rome XLR, or equal.
- E. Other - All conductors for other than general use shall be as specified on the drawings.

2.4 CONDUIT AND FITTINGS

Use Robroy Industries Plasti-Bond red PVC coated conduit with urethane interior coating for all electrical conduits.

2.5 IDENTIFICATION

- A. The Contractor shall be responsible for identification and labeling of all electrical power equipment as required by the latest revision of RFP SE-104 "Standard for the Identification of Electrical Power Systems". Incorporated herein by Reference.

PART III: EXECUTION

3.1 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance. Where any penetrations are necessary for the installation, support, or anchorage of the conduit, raceway, or other electrical work, this work shall be carefully done. Any damage to buildings, piping, or equipment shall be repaired at no expense to the Buyer.

3.2 CIRCUIT BREAKERS

Any installation, preparation, inspection, or performance requirements are included in Part II. Refer to this section for applicable execution requirements. The NEC shall be used as a minimum requirement.

3.3 WIRE AND CABLES

A. General

1. Wires and cables for power, lighting, and control shall, as far as practicable, be continuous from origin to destination without running splices in intermediate pull boxes or outlet boxes. Slack shall be left in all pull boxes and sufficient slack at equipment to allow for neat, workmanlike termination.
2. A wire-pulling lubricant must be used when pulling conductors. If a pulling compound is used, it shall be Minerallac pull-in compound 100 or Ideal Yellow 77.
3. All wires shall be color-coded. The following color code shall be followed explicitly:
 - a. Electrical branch circuit and interior supply-side circuit conductors shall be suitably color-coded, or otherwise labeled, in such manner to be consistent with NEC requirements and with any existing color-coding or labeling system used at the site for ungrounded circuit conductors. This coding or labeling shall identify voltage levels, the grounded conductors, the equipment grounding conductors and ungrounded single-phase or polyphase conductors. The color-coding for low voltage electrical systems, shown below, shall be used, provided it does not conflict with existing color-coding with color-coded tape banding. Phase colors shall be:

	<u>120/208-240</u> <u>Volts</u>	<u>277-480</u> <u>Volts and Above</u>
Phase 1-A	Brown	Black
Phase 2-B	Orange	Red
Phase 3-C	Yellow	Blue
Neutral	Gray	White
Ground	Green	Green

Single-phase circuit power conductors shall be color-coded per phase as indicated. Neutral conductor shall be white or gray, depending on system.

- b. Motor control conductors (generally No. 14) shall be multi-conductor cables with the individual conductor color coded as per the drawings.

- c. Lighting circuit conductors shall be black for phase conductor, white for the neutral conductor, and red for switch leg.
- d. Grounding conductors shall be insulated and green in color.

B. Splices and Terminations

- 1. In connecting wire and cable to equipment, various methods may be used depending upon the local condition. In general, the use of solderless pressure connectors for terminals, taps, and splices is recommended. Buchanan or Stakon PT series splices are acceptable on wire size up to 1/0 and for 1/0 and larger, Burndy KSV Servits shall be used.
- 2. Lugs may be T&B, Stakon, or T&N method squeeze connector or Burndy Hi Press. All splices shall be made with solderless squeeze-type connectors whenever possible.
- 3. All motor lead connections shall be made by bolting the lug of the motor lead back to back with the conductor lug, bolting together with proper size machine screws and using flat washers. Motor connections shall be covered with several layers of rubber and friction tape for vibrating equipment or Scotch No. 33 for other equipment, then a shrink-type cover applied.
- 4. All taped splices 1/0 and larger, except high voltage, shall be taped with several layers of rubber and sufficient wraps of Scotch No. 33 to equal wire insulation, then a shrink-type cover applied.
- 5. High-voltage splices shall be made with 3M Company resin pressure splice or tape splice approved for voltage rating. The Contractor shall furnish the Buyer the material list and splice drawing for approval before making splices. Outdoor terminations with shielded cable shall be installed using resin-pressure method for stress cones and Scotch cast terminal shields, or cable manufacturer's approved method may be submitted for approval.

3.4 CONDUIT AND FITTINGS

A. Conduit

- 1. Conduit systems shall be installed in accordance with the applicable provisions of the NEC.

2. Conduits shall be concealed within the walls, ceilings, and floors where indicated and shall be kept at least 6 in. from parallel runs of steam pipes or hot water pipes. Exposed runs of conduit shall be installed with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right-angle turns consisting of cast metal fittings or symmetrical bends. Bends and offsets shall be avoided where possible, but when necessary, shall be made with an approved hickey or conduit-bending machine. the use of pipe tee or vise for bending conduit will not be permitted. Conduit that has been crushed or deformed in any way shall not be installed. Crushed or deformed conduit shall be replaced at no cost to the Buyer at the discretion of the Buyer. Expansion fittings or other approved devices shall be used to provide for expansion where conduit crosses expansion joints.
3. Wooden plugs inserted in masonry or concrete wall shall not be used as a base to secure conduit supports. Conduit shall be supported on approved types of galvanized wall brackets, ceiling trapeze, or strap hangers. Expansion anchors shall be used in concrete or brick, machine screws on metal surfaces and wood screws on wood construction. Nails shall not be used as the means of fastening boxes or conduits. Conduit shall be installed in such a manner as to prevent the collection of trapped condensation. All runs of conduit shall be arranged so as to be devoid of traps wherever possible. The Contractor shall exercise the necessary precautions to prevent the lodgment of dirt, plaster, or trash in conduit, fittings, and boxes during the course of installation. A run of conduit that has become clogged shall be entirely freed of these accumulations or shall be replaced. Conduit shall be securely fastened to all sheet metal outlet, junction, and pull boxes with galvanized locknuts and one bushing installed in accordance with standard practice. Care shall be observed to see that the full number of threads project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be sufficiently tightened to draw the bushing into firm electrical contact with the box. Wiring shall not be installed in telephone system conduits unless otherwise specified. All conduits for telephone or future electrical installation shall be provided with pull wires.
4. Empty conduit systems for telephone systems shall be installed with pull wires.

5. All telephone conduit sizes shall be verified with the telephone company before installation.
- B. Conduit Fittings. Outlets shall be installed in the locations shown on the drawings. The Contractor shall study the general building plans in relation to the spaces surrounding each outlet in order that his work may fit the other work required. When necessary, the Contractor shall relocate outlets so that when fixtures or other fittings are installed, they will not interfere with other work or equipment. Only zinc-coated or cadmium-plated sheet steel boxes shall be used. Boxes shall be installed in a rigid and satisfactory manner, either by wood screws on wood, expansion anchors on masonry, or machine screws on steel work. One-piece gang boxes not less than 2 in. deep shall be utilized where necessary.
- C. Wall Penetrations
1. Conduit seals shall be used when routing conduit from a potentially contaminated (hot) area to a noncontaminated (cold) area. The seal shall be located on the potentially contaminated side.
 2. Surfaces of joints to be sealed shall be clean, dry, and free from oil, dirt, frost, and foreign matter. Fresh concrete at joints to be sealed shall have cured for at least 7 days prior to sealing.
 3. Ambient temperature shall be above 40°F and below 100°F when sealant is applied.
 4. Clean metal surfaces of corrosion by wire brushing or using chemical cleaners.
 5. Sealant shall be uniformly smooth and free of wrinkles.
 6. Apply caulking sufficiently convex to result in a filled joint that is flush after the sealant has dried.
 7. Clean all sealant from adjacent surfaces.
 8. Follow manufacturer's recommendations.
 9. Silicone sealant. General Electric silicone white Silpruf sealant, shall be installed in accordance with manufacturer's recommended procedure.

3.5 IDENTIFICATION

- A. Equipment to be identified includes but is not limited to:
1. Disconnecting devices that are located in the area.

2. Control panels, starters, pushbutton stations, and other control devices.
3. Receptacles and light switches.
4. Instruments and associated devices.
5. Conduit systems.

B. Legends

1. The Contractor shall be responsible for electrical identification as directed in paragraph 2.5 of this section of these specifications.

3.6 INSPECTION AND ELECTRICAL TESTS

- A. The Contractor shall test, under supervision of the Buyer or his designated representative, all wiring and connections for continuity and grounds, and when directed, he shall demonstrate, by Megger test, the insulation resistance of any circuit or group of circuits. Where such insulation resistance tests indicate the possibility of faulty insulation, the Contractor shall locate the point of fault, replace same with new materials, and demonstrate by further test the elimination of such fault.
- B. All grounds shall be tested and recorded in accordance with the specifications by a double-scale Megger ground tester.
- C. All 480-V 3-phase feeder and feeds shall be given a Megger test and rotation check before being put into operation. The Contractor shall furnish the test equipment.
- D. Records of each inspection and test, together with complete data and readings associated therewith, shall be entered on a form furnished by the Buyer for this purpose. Test data taken and compiled during the inspections shall be certified by the Contractor and Buyer witnessing the tests. Records of the inspections and tests, together with the complete data on all readings taken, shall be made and incorporate into a formal report by the Contractor.
- E. Meggar testing shall be conducted by the Contractor as follows:
 1. After installation and before connecting, splicing or terminating, a continuity check shall be performed on each wire.
 2. After installation and before connecting, splicing or terminating, a "Meggar" test shall be performed on each

insulated conductor used at voltages greater than 150 volts.

3. Where "Meggar" testing is required, the tests shall be made between one disconnected, insulated, conductor, and ground with all other conductors grounded. Each insulated conductor shall be tested in the same manner. The test shall be performed for at least 30 seconds using the 1,000 V setting on the "Meggar". The 100 megohms. Any wire having a "Meggar" reading lower than average by 50 percent or more, even though meeting the minimum requirements, shall be replaced.
- F. After the interior wiring system installation is completed, and at such time as the Buyer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification.

END OF SECTION 16050

SECTION 16140

WIRING DEVICES

PART I: GENERAL

Refer to Section 16010, Part I, for applicable requirements.

PART II: PRODUCTS

2.1 RECEPTACLES: 120-V receptacles shall be as follows or as shown on drawings:

- . Three-wire, 15-A, 125-V, regular
- . Hubbell No. 5261 (single)
- . Hubbell No. 5262 (duplex)

2.2 SWITCHES: For 120-V, single-pole, 20-A, 125-V, Bryant Catalog Item 5861 or Hubbell Catalog Item 9805; for fluorescent lighting loads of 1,200-1,800 W, use Bryant Catalog Item 5431, 30-A, "T" rated, or Bryant Item 4901.

For 120-V, three-way, 20-A, 125-V, Bryant Catalog Item 4967, or Hubbell Catalog Item 9903; for fluorescent lighting loads of 1,200-1,800 W, use Bryant Item 5433, 30-A, "T" rated, or Bryant No. 4903.

PART III: EXECUTION

Refer to Section 16010, Part III, for applicable requirements.

END OF SECTION 16140

SECTION 16150
ELECTRICAL POWER EQUIPMENT

PART I: GENERAL

1.1 MOTORS

A. Rating

<u>Horsepower</u>	<u>Voltage</u>	<u>Phase</u>
1/2 to 150 (inclusive)	230/460	3
Less than 1/2*	115/230	1

* All 3600-rpm motors, and any requiring high-starting torque or where the continuity of operation is vital, shall be 460 V, 3 phase.

Motors smaller than 1/2 hp furnished on machine tools, or other equipment having a 460-V main drive motor, shall be as normally furnished by the manufacturer and shall include any accessories required to operate from the main power supply.

B. Enclosures - All motors shall be open type, unless otherwise specified.

Motors shall be only one of the following, unless otherwise specified:

1. Drip-proof.
2. Totally enclosed fan cooled (TEFC) or totally enclosed non-ventilated (TENV). Where frame size and price are the same, the nonventilated is preferred.
3. Combination of any one of the above enclosures with a totally molded, vacuum-impregnated, encapsulated winding.

C. Frames

1. All motor frames and end-bells shall be National Electrical Manufacturers Association (NEMA) standard.
2. Polyphase motors 1 hp and larger with frames larger than frame 256 shall have cast iron or fabricated steel and end-bells and frames.

- D. Bearings - All motors shall have antifriction ball bearings unless otherwise specified, except fractional horsepower motors which may have sleeve bearings.
- E. Connection Boxes - All polyphase motors 1 hp and larger shall have conduit connection boxes of cast iron or cast aluminum (with threaded opening) or steel plate. On fractional horsepower motors, where the connections are made in the end-bell space rather than in an attached connection box, a screwed conduit connection shall be provided in the end-bell. Where sheet metal terminal boxes are provided, they shall include knockouts for conduit terminations.
- F. Refer to Section 16050, Part I, for additional requirements.
- G. Motor information required of equipment manufacturer:
 - 1. Manufacturer;
 - 2. Voltage rating;
 - 3. Horsepower;
 - 4. Full load speed revolutions per minute;
 - 5. Full load current;
 - 6. Frame number;
 - 7. Enclosure;
 - 8. Mounting (horizontal or vertical);
 - 9. Base (flange or foot);
 - 10. Slide rails (V-belt driven);
 - 11. Temperature rise °C;
 - 12. Insulation class;
 - 13. Rotation (viewed from shaft end);
 - 14. Duty cycle;
 - 15. Location of terminal box; and
 - 16. Special modifications.

1.2 MOTOR CONTROL

- A. Single-Phase Manual Starters - Single-phase manual starters shall consist of a toggle switch, single or double pole, with a thermal overload heater element capable of interrupting the circuit incase of overload. These manual motor starters shall be furnished with a NEMA Type 1 enclosure unless otherwise specified.
- B. Magnetic Motor Starters - Magnetic motor starters shall be installed in all cases where remote control is required and "no-voltage" or "undervoltage" protection is required. Three overload relays, for installation of interchangeable overload relay heaters, shall be furnished with each starter. Operating coil voltage, enclosure, number and position of auxiliary contacts. NEMA size, and all starter modifications shall be as shown on the drawings.

1.3 MOTOR CONTROL CENTERS

- A. Enclosure - Motor control centers shall consist of one or more sections 90 in. high, 20 in. wide, and 20 in. deep. Each section shall include top, bottom, and size wireways; horizontal and vertical bus bars; movable unit support bars; pan-type, gasketed, pin-hinged doors with pressure-type fasteners; and provisions for locking. Each section shall conform to NEMA standard enclosures for NEMA Type 1. Each section shall have standardized construction, dimensions, and all provisions for replacement or addition of vertical sections to either side without adjustments, alterations, or structural changes. Each section shall be provided with removable sections for maintenance and inspection of all interior component parts. All sections shall be cleaned, primed, and painted with standard color.
- B. Bus Bars - Horizontal bus bars shall be rated for 1,000-A capacity with a 50°C rise, silver-plated, and braced for 25,000-A rms fault current. Vertical bus bars shall extend full length of the working area. Each bar shall be silver plated and be braced to withstand 25,000-A rms fault current.
- C. Control Units
 - 1. Motor control centers shall be a combination of standardized combination starter units of NEMA Sizes 1 through 5. The smallest acceptable modular size shall be 12 in. high. Each unit shall be semienclosed and electrically isolated. Each unit shall be equipped with handles for removal from the section. Cam-type or screw-type latches shall postive latch units in operating, test, disconnected, and removed positions.

2. Silver-plated stab-on power connectors shall be furnished, on the back of each unit, to connect the line side of the unit to the vertical bus bars. Load side connections shall be equipped with pressure connectors. Pushbuttons and indicating lights shall be assembled to the control unit. Each control unit shall have all load and control connections wired to a terminal board at the side of the unit. All wiring shall conform to NEMA Class C.

D. General

1. All spare compartments shall be furnished complete with a bus, unit supports, and a matching blank door. All compartments, which contain control units, shall have doors with built-in reset button operators, and circuit breaker operators, in the door. Doors shall have cover interlock latches to prevent the opening of the unit door when the circuit breaker is on. A screwdriver interlock bypass shall be incorporated to permit opening of the door for inspection without interrupting the power. All circuit breaker operators shall be capable of being locked in the open position. All motor controls with remote operators shall have 120-V control systems.
2. Complete shop drawings, schematic, and elementary wiring diagrams shall be approved by the Buyer before purchase of the equipment.

1.4 REMOTE CONTROL UNITS

- A. Pushbuttons, automatic selector switches, and pilot lights shall be of the Allen-Bradley Bulletin 800T oil-tight type.
- B. Limit switches, unless otherwise specified, shall be Allen-Bradley Bulletin 802T oil-tight units.

PART II: PRODUCTS

2.1 MOTORS: Reference this section, Part I.

2.2 MOTOR CONTROL

- A. Single-Phase Manual Starters - Single-phase manual starters shall conform to Allen-Bradley Bulletin 600.
- B. Magnetic Motor Starters - Starters shall conform to the following:
 1. Full-Voltage Starters - Allen-Bradley Bulletin 709.

2. Combination circuit Breaker and starter - Allen-Bradley Bulletin 713.

2.3 MOTOR CONTROL CENTERS: Motor control centers shall be as manufactured by Cutler Hammer, Allen-Bradley, or Westinghouse Electric company and shall comply with Part I, Section 1.3, above.

2.4 REMOTE CONTROL UNITS

A. Refer to Allen-Bradley Bulletin 800T for oil-tight-type pushbuttons, selector switches, and pilot lights.

B. Refer to Allen-Bradley Bulletin 800T for oil-tight-type limit switches unless otherwise specified.

PART III: EXECUTION

Refer to Part III of Section 16050 for applicable requirements.

END OF SECTION 16150

SECTION 16160

PANELBOARDS

PART I: GENERAL

Refer to Section 16050, Part I, for applicable requirements.

PART II: PRODUCTS

2.1 Lighting and appliance branch panelboard as defined as any branch circuit panelboard having more than 10 percent of it's overcurrent devices rate 30 amperes or less for which neutral connections are provided.

A. Enclosures - Cabinet boxes shall be constructed of zinc-coated sheet steel and shall conform to the requirements of the Underwriters' Laboratories, Inc. (UL), Standard for Cabinets and Boxes. Boxes shall be zinc-coated after fabrication. Trims and doors shall have a suitable primer coat and a finish coat of a color specifically designated by the Buyer. Cabinets for panelboards shall be provided with not less than 5-in.-wide wiring gutters at the sides, 6 in. wide at the top and bottom, and 5 3/4 in. deep. Surface-mounted cabinets shall be door-in-door construction. Both doors shall have hinges on the same side. The smaller door covering all overcurrent protective device handles with a combination lock latch. All locks shall be keyed alike. The larger trim door will expose the wire gutter in the panelboard and shall be secured in the closed position with a minimum of three bolts. A directory holder shall be provided on the inside of the smaller door. A neatly typed director, properly identifying each circuit, shall be mounted in the directory holder.

B. Interiors - Panelboard interiors shall be made up with reinforced backpan with a means for adjusting in and out. Easy-access covers shall be provided over lug compartment and neutral bar. All bus bars shall be securely supported from backpan with bus bar insulators and shall not depend on branch circuit breakers for support. All bus bars shall be drilled and tapped full length to facilitate changes. Bolt-on circuit breaker panelboards shall be provided.

A minimum of 25 percent spare circuit spaces shall be designed into each panelboard.

All panelboards shall be equipped with a copper ground bus bar kit.

C. Circuit Breakers

1. All branch circuit panelboards shall be equipped with a main circuit breaker. The main shall be an integral part of the panelboard.
 2. Circuit breakers that are being used to switch lights and other loads on and off at the panelboard shall be switch duty-rated (SWD) circuit breakers.
 3. The uses of new thin or slim line circuit breakers is not acceptable.
 4. All panelboard circuit breakers shall have a minimum interrupting capacity and short circuit rating of 10,000 amperes RMS unless otherwise specified.
 5. The total load on any overcurrent protective device located in a single phase panelboard shall not exceed 80 percent of its rating. A 20 amp circuit breaker is the minimum size braker to be used in panelboards.
- D. Grounding - Panelboard enclosures shall be bonded to the equipment grounding system using conductors sized per the National Electrical Code (NEC).
- E. Panelboard Manufacturers - Complete factory-assembled circuit breaker panelboards for 120/208 volts, 3-phase, 4-wire shall be similar to square "D" type NQOD or Westinghouse Pow-R-Line C or equal. Panelboards shall be equipped with 20 amp branch circuit breakers unless otherwise indicated on the Drawings.

PART III: EXECUTION

Refer to Part III of section 16050 for applicable requirements.

END OF SECTION 16160

SECTION 16402
UNDERGROUND ELECTRICAL SERVICE

PART I: GENERAL

Refer to section 16050, Part I, for applicable requirements.

PART II: PRODUCTS

- 2.1 SERVICE CONDUITS: Conduits for underground service shall conform to the National Electrical Code (NEC).
- 2.2 DUCTS: Underground ducts shall be heavy walled polyvinyl chloride or fiber duct (Orangeburg).

PART III: EXECUTION

3.1 SERVICE CONDUIT INSTALLATION

- A. Conduits for underground electric service shall be installed as shown on the drawings.
- B. Conduits shall be buried a minimum of 3 ft below finished grade.

3.2 DUCT INSTALLATIONS

- A. Duct runs shall be run in north-south and east-west coordinates. Diagonal runs will not be permitted.
- B. Duct runs shall be installed as straight as possible, with duct supported on spacers designed for that purpose. When bends are necessary, 5-degree couplings shall be used to make large radius bends. A tooling lathe designed for the type of duct being used shall be used to taper all joints. Drawknife or other makeshift arrangements will not be acceptable. Use manufacturer's sealing compound in all joints.
- C. Duct runs shall be encased in concrete with no less than 3 in. of concrete between ducts and no less than 4 in. around the outside periphery.
- D. When multiple duct runs are installed, they shall be banded together with steel banding wire no less than 5 ft on center.
- E. All duct runs shall be tied down in an acceptable manner. The Buyer shall inspect all duct installations before concrete is poured.

- F. A pull wire shall be installed in each duct run. This wire shall be pulled into each duct as it is installed. Under no circumstances shall any amount of duct be installed without pull wire. The pull wire shall be No. 9 steel wire securely fastened at each end or completion of installation.
- G. During construction, duct runs shall be plugged at the end of each working day with duct plugs.
- H. Upon completion of duct runs, the Contractor shall pull a swab through ducts, then a mandrel 1/2 in. less in diameter than the duct to ensure straight, clean unbroken lines. This shall be witnessed by the Buyer. Plugs shall be drilled for pull wire and then installed in spare ducts with pull wire securely attached at each end.

3.3 TRENCHING AND BACKFILL

- A. Trenching shall be of size and location as shown on the drawings. All trenching shall be kept free of water, debris, and foreign materials. Care shall be taken that trenches are properly sloped, where depth and job condition indicate a possible safety hazard to personnel, and approved by the Buyer. Activities shall comply with OSHA standards (1986).

The use of shoring and trench bracing may be required by the Buyer at no additional cost to the Buyer.

- B. All backfill shall be done in 6-in. layers with each layer compacted 98% according to the Modified Proctor Method.
- C. The backfill in the immediate area of cable or conduit shall be done with clean sand to a depth of 6 in. above cable or conduit. succeeding layers of backfill may be with fill material compacted after each layer.

END OF SECTION 16402

SECTION 16450

GROUNDING

PART I: GENERAL

1.1 WORK INCLUDED

- A. Work under this section includes providing grounding systems as shown on the drawings and as specified herein.
- B. Furnish all labor, materials, tools, and equipment and perform all work and services necessary for or incidental to the erection and installation of the equipment in this section, complete with accessories, as shown on the contract drawings and as specified herein, in accordance with the provisions of the contract documents, and completely coordinated with that of all other trades.
- C. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation of equipment in this section shall be provided as part of this work.

1.2 QUALITY ASSURANCE - REFERENCED SPECIFICATIONS AND DOCUMENTS: Comply with the provisions of the following defined codes, standards, and specifications, except as otherwise noted or specified. Where a conflict occurs, the more stringent requirement shall govern. The publications listed below are referred to in the text by the basic designation only.

- 1) National Electrical Code (NEC), latest edition.
- 2) Institute of Electrical and Electronic Engineers (IEEE) Standard 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- 3) All electrical materials shall be new and as listed by the Underwriters' Laboratories, Inc. (UL), except as otherwise specified herein.

PART II: PRODUCTS

2.1 GROUNDING ELECTRODES

- A. Grounding electrodes shall consist of 3/4-in. or larger galvanized steel pipe or 5/8 - in. or larger galvanized or copper-clad steel rods.
- B. The preferred electrode shall be the copper-clad steel rod, 10 ft long.

- C. The standard length electrode shall be 10 ft. Where electrodes are longer than the standard, their length shall be clearly marked near the top.
- D. The size of the electrode used will depend on its length and the driving quality of the soil. It shall, if possible, be long enough to reach permanently moist earth below the frostline.

2.2 CONDUCTORS

- A. Equipment Grounding Conductor - The equipment grounding conductor shall be an insulated (green) copper conductor.
- B. Grounding Electrode Conductor - The grounding electrode conductor shall be copper.

PART III: EXECUTION

3.4. STANDARD GROUNDING SYSTEM OR MAIN LOOP

- A. A standard grounding system or main loop shall consist of a grounded loop of bare stranded copper wire, buried at a depth of at least 3 ft below grade, and completely encircling the building or structure.
- B. The distance between grounds on this loop shall not exceed 50 ft. At least two grounds shall be used, and where only two are required, each shall consist of three ground electrodes driven at the corners of an 8-ft equilateral triangle and banded together. They shall be located on opposite sides of the building, perfectly at opposite corners.
- C. The loop shall be further bonded to the steel of steel frame buildings, all isolated grounds, and where practicable, to metal underground water and sewer piping systems, steel piling, well casings, etc.
- D. The main ground loop and its connections to driven electrodes and other ground terminals, shall not be smaller than size No. 1/0.

3.2 PIPE AND ROD ELECTRODES

- A. Electrodes shall be driven at a distance of not less than 3 ft from the building foundation walls or structure footings.
- B. Where convenient, and with the approval of the Buyer, they may be driven in the bottom of excavations.
- C. Where ground electrodes are part of a loop or standard grounding system, their tops shall be driven below grade.
- D. Pipe electrodes shall be fitted with ground points and caps.

- E. Isolated ground electrodes shall be left with their tops projecting 6 in. above the grade so that the removable connectors are accessible for inspection and testing of ground resistance.

3.3 GROUND CONNECTIONS

- A. All ground connections shall be bolted or brazed.
- B. In order to ensure a low-resistance joint, care shall be taken in cleaning and preparing the contact surfaces.
- C. The ground terminal at piping or tanks shall consist of 1/4- X 2-X 2-in. copper bar, brazed to the pipe or tank, to which is bolted a clamp-type terminal plug.
- D. Connections of ground leads to isolated electrodes shall be made with bolted clamp-type connectors to facilitate removal for testing.
- E. Disconnectors shall be installed in group leads to a standard grounding system or main loop.
- F. No ground connections shall be made to gas piping.

3.4 EQUIPMENT GROUND SYSTEM

- A. All metallic raceways, electrical equipment, and related enclosures shall be continuously grounded.
- B. A separate equipment-grounding conductor (green wire) shall be installed in all raceways for feeders, branch circuits, etc., regardless of size, location, or length.

3.5 STATIC GROUNDING

- A. Any metal surface which a nonconducting static-producing flammable liquid with brass washers against clean faces or flanges or by bare flexible copper wire jumpers, using No. 6 as the minimum wire size.
- B. Gasketed flanges shall be bonded either by using at least two brass bolts with brass washers against clean faces of flanges or by bare flexible copper wire jumpers, using No. 6 as the minimum wire size.
- C. Parallel pipe lines shall be bonded and grounded at 30- to 40-ft intervals and at every point where the cross within a few inches of each other or as indicated on the drawings.

3.6 TESTING GROUNDS

- A. All ground shall be tested and recorded in accordance with the specifications by a double-scale (0-30 and 0-300 ohm) Megger ground tester, Type MEG, as manufactured by James G. Biddle Company.
- B. Records of each inspection and test, together with complete data and readings associated therewith, shall be entered on a form furnished by the Contractor for this purpose. Test data taken and compiled during the inspections shall be certified by the Contractor and witnessed by the Buyer. Records of the inspections and tests, together with the complete data on all readings taken, shall be made and incorporated into a formal report.
- C. The lowest possible resistance to ground is desirable. It shall not exceed 5 ohms.

END OF SECTION

SECTION 16460

TRANSFORMERS

PART I: GENERAL

- 1.1 CONTROL TRANSFORMERS: Control transformers shall be 50 V-A or larger.

PART II: PRODUCTS

- 2.1 CONTROL TRANSFORMERS: Control transformers shall be Jefferson Electric Company of equivalent.

PART III: EXECUTION

- 3.1 Refer to Section 16050, Part III, for applicable execution requirements.

END OF SECTION 16460

SECTION 16510
LIGHTING FIXTURES

PART I: GENERAL

Refer to Section 16050, Part I, for other requirements.

1.1 LIGHTING FIXTURE REQUIREMENTS

- A. The Contractor shall furnish and install all lighting equipment and lighting fixtures included in the fixture schedule and for all outlets, as indicated on the drawings.
- B. All lighting fixtures shall bear the Underwriters' Laboratories, Inc. (UL), label, manufacturer's label, and proper union label.
- C. Interior wiring of all fixtures shall be Type "AF" fixture wire of 16 gage for fixtures up to and including 200 W. Fixtures over 200-W capacity shall be wired with 14-gage wire.
- D. All fixtures shall be such that all parts will be continuously grounded.

1.2 FLUORESCENT FIXTURES

- A. All fluorescent lampholders shall be the white phenolic compound, positive spring-action type.
- B. Fluorescent fixtures shall be supported at all points as required for good practice and adequate support. The Contractor shall furnish all supports required, including structural members if required. Unistrut supports are acceptable.
- C. All fluorescent fixtures shall be equipped with thermally protected, high-power-factor ballasts that are UL and Current Bid Monitor approved. All ballasts shall be Type "P" ballasts.

1.3 LAMP BULBS: All lamp bulbs for the fixtures shall be government-furnished. The Contractor shall request all lamps required for the job by submitting a complete list of all types and sizes required.

1.4 REFERENCE STANDARDS

- A. Rocky Flats Plant Standard No. SE-202.

PART II: PRODUCTS

2.1 MANUFACTURERS

- A. Fluorescent Fixtures - Fluorescent fixtures shall be rapid start, manufacturer and catalog number as indicated in the lighting fixture schedule on the drawings.

2.2 EMERGENCY LIGHTING: Emergency lighting shall be Holophane type EH-12.

PART III: EXECUTION

Refer to Section 16050, Part III, for applicable requirements.

END OF SECTION 16510

SECTION 16601

LIGHTNING PROTECTION SYSTEMS

PART I: GENERAL

1.1 WORK INCLUDED

- A. Furnish all labor, materials, tools, equipment and perform all work and services necessary for or incidental to the erection and installation of the equipment in this section, complete with accessories, as shown on the Drawings and as specified herein, in accordance with the provisions of the contract documents and completely coordinated with that of all other trades.
- B. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation of equipment in this section shall be provided as part of this work.

1.2 QUALITY ASSURANCE--REFERENCED SPECIFICATIONS AND DOCUMENTS: Comply with the provisions of the following defined codes, standards, and specifications, except as otherwise noted or specified. Where a conflict occurs, the more stringent requirement shall govern. The publications listed below are referred to in the text by the basic designation only.

- A. Underwriters' Laboratories, Inc. (UL)
 - UL-96 "Standard for Safety"
"Lightning Protection Components"
 - UL-96A "Standard for Safety"
"Installation Requirements for Lightning Protection Systems"
 - UL-467 "Grounding and Bonding Equipment"
- B. National Fire Protection Association (NFPA)
 - NFPA-78 "Lightning Protection Code"
- C. Lightning Protection Institute (LPI)
 - LPI 175 "Standard Practice"

PART II: PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where a mechanical hazard is involved, the conductor shall be protected by covering with molding or tubing made of non-magnetic material as shown on the drawings.
- B. Main and Secondary Conductors--Conductors shall be in accordance with NFPA 78 and UL 96 and LPI 175.
- C. Air Terminals--Terminals shall be in accordance with UL 96 and NFPA 78 and LPI 175.
- D. Ground Rods--Rods shall conform to UL 467 and shall be made of copper-clad steel. Except where otherwise specified, ground rods shall be not less than 3/4 in. in diameter and 10 feet in length. (Paragraph D - not applicable for this project.)
- E. Clamp-Type Connectors--Connectors for splicing conductors shall be in accordance with UL 96 and LPI 175.
- F. Bonding Plates--Bonding plates shall be in accordance with UL 96 and LPI 175.
- G. Grounding Electrodes--Electrolytic type ground rods shall be provided per Section 16450, Paragraph 2.1.

PART III: EXECUTION

- 3.1 GENERAL REQUIREMENTS: The lightning protection system, except as specified herein, shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground without passing through any non-conducting parts of the structure.
- 3.2 The Contractor shall provide a complete lightning strike protection/prevention system for the Building 891 and tanks included in 881 Hillside Remedial Action.

The lightning strike protection/prevention system shall be provided based on written recommendations from Lightning Eliminators and Consultants, Inc. (Boulder, Colorado), Thompson Lightning Protection, Inc. or other Buyer-approved consultant of equal qualifications. Recommendation letter shall list all items to be provided for proper site protection. The letter shall also state that, with items noted in letter installed, the facility is properly protected against lightning strikes.

3.3 The Lightning Strike Protection/Prevention Manufacturer/Supplier shall be Lightning Eliminators & Consultants, Thompson Lightning Protection, Inc. or Buyer-approved equal. The system shall include as a minimum the following items all mounted, connected and inspected by the manufacturer's representative:

- A. Air terminals.
- B. Conductors including roof conductors and down conductors.
- C. Grounding wire, ground rod clamps, and ground rods.
- D. Fasteners, connectors, clamps, and fittings.
- E. Splices and clamps.
- F. All conduit, cable, wire, connections, excavation, installation, etc. required for complete system installation.
- G. Complete drawings of system components and installation location plans for this project. Drawings shall show project structures and locations of all air terminals, dissipation arrays, conductors, ground connections, etc.

3.4 The Lightning Strike Protection System shall meet all pertinent requirements of all applicable codes and standards including Lightning Protection Institute (LPI) Standard LPI 175, UL 96A and NFPA 78.

The lightning strike protection system shall comply with UL "Requirements for Master Label" and be awarded this label.

The lightning strike protection system shall meet all requirements of LPI Standard 175 and be provided with an LPI Systems Certificate.

3.5 GROUND CONNECTIONS: Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.6 GROUNDING ELECTRODES: A grounding electrode shall be provided for each down conductor located as shown. A driven ground shall exceed into the earth for a distance of not less than 2 feet nor more than 8 feet from the structure. All connections between ground connectors and grounds shall be electrically continuous. All

grounding electrodes shall be connected together with continuous runs of 4/0 bare copper ground cable.

3.7 TESTING GROUNDS

- A. All grounds shall be tested and recorded in accordance with the specifications by a double-scale (0-30 and 0-300 ohm) Megger ground tester, Type MEG, as manufactured by James G. Biddle Company.
- B. Records of each inspection and test, together with complete data and readings associated therewith, shall be entered on a form furnished by the Buyer for this purpose. Test data taken and complied during the inspections shall be certified by the Contractor and with the Buyer witnessing the tests. Records of the inspections and tests, together with the complete data on all readings taken, shall be made and incorporated into a formal report for the Buyer.
- C. The lowest possible resistance to ground is desirable. It shall not exceed 5 ohm.

END OF SECTION 16601

SECTION 16610

CATHODIC PROTECTION SYSTEM FOR STEEL EFFLUENT TANKS

PART I - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. Military Specification (Mil. Spec.) MIL-I-1361C, Instrument, Auxiliaries, Electrical Measuring, Shunts, Resistors, and Transformers.
- B. National Association of Corrosion Engineers (NACE) Standard RP0388, Impressed Current Cathodic Protection of Internal Submerged Surfaces of Steel Water Storage Tanks.
- C. American National Standards Institute (ANSI) Standard C97.1-1972, Low-Voltage Cartridge Fuses 600 Volts or Less.
- D. American Society for Testing and Materials (ASTM) Publication, D 1248-84, Polyethylene Plastics Molding and Extrusion Materials.
- E. National Electrical Manufacturers Association (NEMA) Standards: PV 3-1973 (R 1979), Safety Code for Semiconductor Power Converters.

ST 1-1978, Specialty Transformers (Except General-Purpose Type).

TC 2-1983, Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80).

TR 1-1980 Incl Rev 1 and 2, Transformers, Regulators, and Reactors.

WC 5-1973 (R 1979) Incl Rev 1 thru 11, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- F. National Fire Protection Association (NFPA) Standard 70-1984, National Electrical Code.
- G. Underwriters Laboratories Inc. (UL) Publications:

UL 6, Rigid Metal Conduit (Oct. 23, 1981, 9th Ed.; Rev Oct. 10, 1983; Errata Aug. 29, 1986).

UL 467, Grounding and Bonding Equipment (Nov. 22, 1984, 6th Ed., Rev thru Apr. 30, 1985).

UL 506, Specialty Transformers (Dec. 26, 1979, 9th Ed., Rev thru Sep. 3, 1986; errata Dec. 26, 1984).

UL 510, Insulating Tape (Jan. 26, 1982, 5th Ed.; Rev Mar. 16, 1982).

UL 514A, Outlet Boxes and Fittings (May 14, 1979, 6th Ed., Rev thru Jun. 1, 1982).

- 1.2 GENERAL REQUIREMENTS: The cathodic protection system shall consist of the indicated system design. The Contractor shall provide and install all equipment, wiring, and wiring devices necessary to produce a continuous flow of direct current from electrodes in the electrolyte to the metal tank surfaces and shall place the system in operable status. The Contractor shall install complete automatic cathodic protection to prevent corrosion on the interior submerged surface of the water tank. The design and installation shall meet the criteria and protection outlined below in CRITERIA OF PROTECTION for a 15-year life. The purpose of the system is to adequately and efficiently protect the surfaces of the metal against corrosion where the surfaces are in contact with water; this is in addition to the protective coating in the tank. The contract drawings indicate the location and size of the tank and the design of the system based on an impressed current system. The Contractor may modify the cathodic protection system after site verification and analysis if the proposed modification will provide equal or better overall system performance. This modification must be fully described and submitted by the Contractor and approved by the Buyer. Modifications or additional anodes shall be at no additional cost to the Buyer. Any modification shall incorporate all requirements of this Specification.

The intent of this Specification is to use this impressed current system as described, with anodes as found necessary in calculations and submitted data. Anodes shall be installed in sufficient number and of the required type, size, and spacing to obtain a uniform current distribution of 2.0 milliamperes per square foot to all submerged surfaces in the tank when filled with water to the over-flow level. The anodes shall be so suspended from the roof steel that the hangers or supporting cables are electrically isolated from the metal roof. The anodes shall be supported and restrained, as indicated on the drawings so that there will be no dislocation or other detrimental effects due to the water movement in the tank.

- A. Verification of Site Conditions: The Contractor shall coordinate and properly relate this work to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work

and working conditions, shall verify existing conditions in the field, determine the exact locations of the tank to be protected, and advise the Buyer of any discrepancy before performing any work. The Contractor shall take resistivity measurement of the water and analysis of the water and provide this data with detail drawings of the system for approval by the Buyer. If water is not available for testing as required herein, the Buyer will provide an estimated water quality from which the Contractor shall estimate water resistivity.

- B. Services of Corrosion Engineer: The Contractor shall obtain the services of a corrosion engineer to supervise, inspect, and test the installation and performance of the cathodic protection system. Corrosion engineer refers to a person, who by reason of his knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control on steel water tanks. Such person may be a licensed professional corrosion engineer or may be a person accredited by the National Association of Corrosion Engineers if such licensing or certification includes suitable experience in corrosion control on steel water tanks.
- C. Workmanship: All material and equipment shall be installed in accordance with the recommendations of the manufacturer as approved by the Buyer to conform with the contract documents. The installation, including testing, shall be performed by an organization that has had not less than 3 years experience in this type of work or a professional engineer registered in corrosion engineering. The installation of this system shall be supervised by a registered corrosion engineer or an individual who has satisfied the requirements of accreditation as a corrosion specialist or senior technologist by the National Association of Corrosion Engineers or by a supervisor approved by the Buyer. The supervisor shall be on the site during construction and testing.
- D. The supervisor or corrosion engineer shall insure that all cathodic protection system is installed, tested, adjusted, and placed into service in accordance with the requirements specified. He shall also insure quality control.
- E. Rules: The installation shall conform to the applicable rules of NFPA 70.

1.3 SUBMITTALS:

- A. Detail Drawings: Within 45 days after the date of award of the contract, and before commencement of any work, detail

drawings of the proposed cathodic protection installation shall be submitted in sextuplicate for approval. The drawings shall provide tank dimensions and show anode arrangement for both elevated and sectional views of the tank, anode size and number, anode material, anode suspension details, conduit size, wire size, rectifier size and location, handhole details, wiring diagram, and any other pertinent information considered necessary for the proper installation and performance of the system. Shop drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function as a unit.

- B. Approval of Materials and Equipment: Within 45 days after date of receipt of notice to proceed and before commencement of installation of any materials or equipment, the Contractor shall submit for approval a complete list of materials and equipment to be incorporated in the work. The list shall include cuts, diagrams, and such other descriptive data as may be required by the Buyer for the following list of materials and data. Partial lists submitted from time to time will not be considered.

Water resistivity and water analysis;

Conductors;

Anodes;

Coating material in areas where welding and other work is accomplished;

Insulated resistance wire;

Layout of anodes in tanks, test stations and isolation points, and grounding;

Special details;

Certified experience data of installing firm and qualifications of corrosion engineer;

Exothermic weld equipment and material;

Test station;

Welding method for electrical connections; and

Procedure for rectifier testing and adjustment.

Calculations for:

1. Total current required for system;

2. Life of the anodes; and
3. Anode geometry (showing areas of coverage).

All detail drawings for the work covered in this section shall be submitted at one time as a single submittal in order to demonstrate that the items have been properly coordinated and will function properly as a unit. A notation shall be made on each shop drawing submitted as to the item's specific use, either by a particular type number referenced on the Drawings or in the Specification, or by a description of its specific location.

- C. Certification: Certification shall be submitted with the shop drawings giving the name of the firm, the number of years of experience, and a list of not less than five of this firm's installations three or more years old, that have been tested and found satisfactory.
- D. Name and Qualifications: The corrosion engineers and/or supervisor's name and qualifications shall be certified in writing to the Buyer prior to the start of construction.
- E. Operating and Maintenance Instructions:
 1. Operating instructions outlining the step-by-step procedures required for system start-up and operation shall be furnished by the Contractor. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features.
 2. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs shall be furnished by the Contractor. The instructions shall include diagrams for the system as installed, the instructions in making tank-to-reference electrode measurements and frequency of monitoring.
- F. Spare Parts Data: After approval of the shop drawings and not later than 3 months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of materials and equipment specified. The data shall include a complete list of parts, special tools, and supplied, with current unit prices and source of supply.
- G. Training Course: The Contractor shall conduct a training course for operating staff as designated by the Buyer. The training period shall consist of a total of 24 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests.

- H. Performance test reports: Upon completion and testing of the installed system, test reports shall be submitted by the Contractor in booklet form tabulating all field test and measurements. Each test report shall indicate the final position of controls.

PART II PRODUCTS

2.1 IMPRESSED CURRENT ANODES:

- A. Ceramic Anodes: Ceramic-metal multi-layer composite anodes shall conform to the following requirements.
1. Anodes shall consist of a thin layer of a platinum group metal/valve metal (Niobium) mixed metal oxide ceramic deposited onto a copper cored valve metal (Niobium) wire substrate, as manufactured by APS-Materials, Inc. of Dayton, Ohio, or equal.
 2. Anode wire shall be of 0.062-inch diameter. Anode length shall be as shown on the Drawings.
 3. Anode wire shall be spirally wrapped around a 1/2-inch diameter polypropylene rope for support and suspension. An electrical shield shall be attached to the lower end of the rope to eliminate overpolarization of the tank bottom and coating disbondment immediately under the anode wire end. The shield shall be an 18-inch diameter, 1/2-inch thick Kynar coated steel plate. The shield will also eliminate anode wire movement (swinging) during the tank filling and emptying.
 4. Anode wire shall be continuous.
- B. Anode Connecting Cables: Anodes shall have connecting cables installed at the factory. The Contractor shall submit a certified test report showing that the connecting method has passed a 120-day laboratory test without failure at the place of connection wherein the anode was subjected to maximum recommended current output while immersed in a 3 percent sodium chloride solution. The cable-to-anode connection resistance shall not exceed 0.003 ohm.

2.2 RECTIFIERS AND ASSOCIATED EQUIPMENT:

- A. Rectifier Unit: Rectifier unit shall be solid-state, air-cooled and consist of the necessary potential control circuit, transformers, rectifying elements, circuit breaker, meter, wiring, terminals, and appurtenances of adequate capacity to meet the requirements of the system. Transformer voltage tap adjusters shall not be used to control the operation of the power unit. The entire power unit shall be field serviceable.

2. Power unit shall be designed to operate on 115 volts, 1 phase, 60 hertz, input.

The power unit/controller shall have the following standard features:

- a. Expected life in excess of 15 years.
- b. Auto-restart after power outage.
- c. Short circuit and surge protection.
- d. Dead front panel.
- e. Accept all standard reference electrodes.
- f. Digital readout.
- g. FCC approved.
- h. Adjustable current limit.
- i. Illuminated panel display.
- j. Display potential for any operating mode continuously or on demand.
- k. Automatic temperature compensating circuit.
- l. Clock circuit.
- m. Fingertip panel control.
- n. RS232 compatibility.

One rectifier shall be used for protection of each tank. Upon completion of installation of the anode system and permanent reference electrode at each location shown, the Contractor shall connect a temporary, adjustable dc power supply to the anodes and the tank. The required dc output voltage rating of each power unit shall be established prior to its purchase. Procedure for determining power unit dc output voltage ratings shall be as follows:

- a. A temporary adjustable dc power supply shall be connected into the cathodic protection circuit exactly as the power unit will be connected.
- b. The dc power supply shall be adjusted until the dc output current (required 2.0 ma per sq. ft.) rating of the power unit is achieved.

- c. The voltage required to achieve the dc output current from the adjustable dc power supply equal to the specified rated dc output current of the power unit, shall be multiplied by 1.5 to obtain the required dc voltage output rating of the power unit. Alternate methods for determining rated dc output voltage required for each power unit may be used only if they are approved by the Buyer. Upon determination of the required rated dc output voltages, the power units shall be purchased and installed in preparation for continuation of tests and measurements.
2. The transformer shall conform to UL 506 and NEMA ST 1, or NEMA TR-1, as applicable. The transformer shall be of the separate primary and secondary type and shall withstand continuous operation 10 percent above rated input voltage at the maximum rated output. The transformer shall be designed for a maximum hot spot heat rise not to exceed 50 degrees C (122 degrees F).
3. Rectifying elements shall conform to NEMA PV 3 and shall be silicon diodes connected in such a manner as to provide full-wave rectification. Silicon diodes shall be protected by selenium surge cells or varistors against over-voltage surges and by current limiting devices against over-current surges.
4. Digital Display: A single digital display on the control panel shall indicate voltage, current and structure potentials as selected by the Buyer. Analog voltmeter, ammeter, and potentiometer may also be used in lieu of a digital meter. All measurement or setting shall be displayed for verification of adjustment.
5. A single-pole, flush-mounted, fully magnetic, properly rated non-thermal type circuit breaker shall be installed in the primary circuit of the rectifier supply transformer.
6. Cartridge-type fuses conforming to ANSI C97.1 with suitable fuse holders shall be provided in each leg of the dc circuit.
7. Control Circuits: The control circuit of the power unit shall be designed to continuously monitor the potential of the structure and automatically regulate the protective current as required to maintain the potential at the preselected level. The system shall be capable of maintaining a tank-to-water potential criterion of protection within plus or minus 0.025 volt regardless of changes in water chemistry, temperature, or water level in the tank. Provision shall be made

for readily changing the range and limits of the criterion. A microprocessor shall be used for overall system control and phase controlled SCR's for current regulation.

8. Mode of Operation: The power unit shall be capable of operating in the following three (3) modes with the selection of the desired operating mode made on the front panel without additional equipment or tools.

Manual Mode: The power unit shall operate as a conventional rectifier continuously delivering preselected current to the anodes. In this mode, the automatic control shall be locked out without affecting the preprogrammed settings for other modes of operation. The output of the power unit shall be regulated from 0-100 percent of rated capacity without the use of transformer taps.

Auto-1 Mode: In the Auto-1 mode, the controller shall automatically and continuously monitor the potential of the structure and make necessary adjustments in the current output to maintain the structure potential at the preselected value. A single reference electrode placed within 1 to 2 cm. from the protected structure shall be used to measure the potential and control the operation of the power unit.

This mode will be used when monitoring potentials at the submerged surfaces of a well-coated tank where potentials must be maintained within a precise range.

Auto-2 Mode: The Auto-2 mode shall function the same as Auto-1 except the potential shall be monitored against a reference electrode located some distance from the protected structure. The measured potential shall be free of IR drop error. This mode shall be used after the coating has deteriorated. In the event coating is of poor quality, use Auto-2 mode and advise the quality control inspector.

- B. Cabinet: Cabinet shall be NEMA 4 and shall be constructed of not lighter than No. 16-gage steel, and shall be provided with a full door. The door shall be hinged and have a hasp that will permit the use of a padlock. The cabinet shall be fitted with screened openings of the proper size to provide for adequate cooling. Holes, conduit knockouts, or threaded hubs of sufficient size and number shall be conveniently located.

1. A complete wiring diagram of the power unit showing both the ac supply and the dc connections to anodes and the tank shall be on the inside of the cabinet door. All components shall be shown and labeled.
 2. Grounding provisions shall comply with NFPA 70 and UL 467 including a ground terminal in the cabinet. The grounding conductor from the terminal to the earth grounding system shall be solid or stranded copper not smaller than No. 6 AWG. The earth grounding system shall consist of one or more 5/8-inch diameter copper-clad steel rods. Ground rods shall be 8 feet long minimum.
 3. The cabinet and supporting mounting shall be painted with the manufacturer's standard paint system.
- C. Wiring: Wiring shall be installed in accordance with NFPA 70 utilizing type TW and RHW or polyethylene insulation. Fittings for conduit and cable work shall conform to UL 514. Outlets shall be of the threaded hub type with gasketed covers. Conduit shall be securely fastened at eight foot intervals or less. Splices shall be made in outlet fittings only. Conductors shall be color coded for identification, as indicated.
- D. Cable Identification: A heat shrinkable, color coded, and numbered sleeve shall be installed on each cable in rectifier, rectifier controller, and junction box to identify to which anode group and reference electrode the cable is connected. Sufficient heat shall be applied to all heat shrinkable sleeves (markers) to shrink them down to form a firm bond to the outside diameter of the conductor. Cables entering and leaving rigid steel conduits shall be positively and plainly identified by permanent cable markers or tags.

2.3 MISCELLANEOUS MATERIALS:

- A. Reference Electrodes: The electrodes shall be copper-copper sulfate type provided with micro-pore diffusion window for water contact and watertight plug for renewal of copper sulfate crystals and solution. A minimum of four reference electrodes shall be part of this system. Electrodes will be designed for a ten year life. The reference electrode wires shall be terminated inside the rectifier controller.
- B. Automatic Cathodic Protection Control: The system shall be capable of maintaining a tank-to-water potential criterion of protection within plus or minus 0.025 volt regardless of changes in water chemistry, temperature, or water level in the tank. Provision shall be made for readily changing the range and limits of the criterion. The controller shall be

either housed integrally with the rectifier or in a separate weatherproof cabinet with provisions for locking. The automatic controller shall be of completely solid-state design, and shall be capable of automatically maintaining the tank-to-water potential at (minus) 900 millivolts with respect to a copper-copper sulfate reference electrode within an accuracy of 25 millivolts. The tank-to-water potential measured and maintained by the controller shall be free of "IR" drop error.

- C. Tank-to-Water Potential Meter: The controller shall be equipped with a calibrated voltmeter having an internal impedance exceeding 1 megohm which shall be so connected to read, from the system reference cell, the tank-to-water potential being maintained by the cathodic protection system. This voltage reading shall be free of "IR" drop error. Two additional test terminals shall be provided inside the Controller for potential measurements using a hand held high impedance voltmeter, as necessary.
- D. Calibrated Shunts: Shunts shall conform to Mil. Spec. MIL-I-1361.
- E. Electrical Wire and Associated Materials:
 - 1. Anode connecting wire for the anodes shall be minimum No. 8 AWG stranded copper wire with type CP cross-linked modified polymer, inner jacket, and modified polyolefin, black outer jacket, 0.32-inch to 0.36-inch O.D. Cable-to-anode contact resistance shall be 0.003 ohms maximum.
 - 2. Cable for anode header and negative cable shall be minimum No. 2 AWG stranded copper wire with type CP high molecular weight polyethylene, 7/64-inch thick insulation, 600-volt rating, in accordance with NEMA WC 5.
 - 3. Reference electrode wire shall be No. 8 AWG stranded copper wire with NFPA 70 type RHW-USE or polyethylene insulation.
- F. Conduit: Rigid galvanized steel conduit and accessories shall conform to UL 6. Non-metallic conduit shall conform to NEMA TC 2.
- G. Test Boxes and Junction Boxes: Boxes shall be outer door type conforming to UL 514.
- H. Polyethylene Insulation: Polyethylene insulation shall comply with the requirements of ASTM D 1248 and of the following types, classes, and grades:

1. High molecular weight polyethylene shall be Type I, Class C, Grade E5.
 2. High density polyethylene shall be Type III, Class C, Grade E3.
- I. Pressure-Sensitive Vinyl Plastic Electrical Tape: Tape shall conform to UL 510.

PART III - EXECUTION

3.1 GENERAL

- A. The Contractor shall strive to avoid damage to the tank coating system during construction of the cathodic protection system.
- B. Damage to the tank coating system shall be repaired as specified under PAINTING.
- C. No welding will be permitted to the tank proper unless shown on the Drawings or without the approval of the Buyer.

3.2 ANODES:

A. Anode Installation:

1. Anodes shall be suspended from roof by means of factory installed connecting wire designed to support the anodes in air (before submergence) without failure of the electrical wire insulation or the electrical conductor.
2. Anodes shall be suspended in a way that will prevent contact with tank surfaces and shall be hung clear of man-access roof hatches and such items as ladders, and other internals.
3. Anode hangers shall electrically insulate the anode suspending wire from the tank steel.
4. A nozzle having a minimum diameter of 4 inches shall be provided in the tank roof for each anode string to permit replacement or inspection of anodes.

B. Anode Connections:

1. Anodes shall be electrically connected to the positive dc header cable with compression connectors or split bolts, or the header cable may terminate in a junction box for connection with all anode cables. A minimum of two split bolts shall be used for each connection if split bolts are used.

2. Header cable shall be installed on the external side of the roof. External wiring shall be in conduit.

3.3 RECTIFIERS:

- A. Rectifier and Controller Installation: Mounting shall be as shown.
- B. Grounding: The grounding system for grounding rectifier cabinets shall have a resistance to earth of not more than 25 ohms as determined by an approved method.

3.4 PERMANENT REFERENCE ELECTRODES:

- A. Calibration: Permanent reference electrodes shall be calibrated against a standard electrode before installation. Calibration shall be done in a test tank containing water with the same composition as the tank to be protected. The permanent electrodes shall measure reference voltage agreeing with that measured by the standard electrode within plus or minus 0.005 volt when the sensing windows of the two electrodes being compared are not more than 1/6-inch apart but not touching.
- B. Installation:
 1. Installation of permanent reference electrodes shall be made at points in the tank which will monitor minimum and maximum tank-to-water potentials as needed for automatic control system.
 2. Sensing windows of reference electrodes shall be located between 1.0 cm and 2.0 cm away from the steel surface sensed and shall be fixed in position preventing contact with tank steel.
 3. Reference electrode for the tank shall be a probe type electrode installed through the tank wall.

3.5 CRITERIA OF PROTECTION: Criteria of protection shall comply with the requirements of RP-0388-88.

- A. Minimum: The criterion of protection shall be a negative voltage of at least minus 0.85 volt as measured between the tank and a saturated copper-copper-sulfate reference electrode. Determination of this voltage shall be copper-sulfate reference electrode. Determination of this voltage shall be made with the cathodic protection system in operation and free of IR-drop.
- B. Maximum: In order to mitigate disbonding of the interior coating in the tank, potential between a copper-copper-sulfate reference electrode and the tank at any point shall

not be more negative than minus 1.05 volt measured with the electrode located between 1.0 cm and 2.0 cm away from the steel surface but not touching it.

3.6 TESTING, ADJUSTING, AND PLACING IN SERVICE:

- A. Testing: Upon completion of the installation, the tank shall be filled to maximum working level. The rectifier shall be energized and adjusted to provide current to the anodes at the level that will protect the tank. The measurements shall be made with voltmeters having input impedance not less than 1.0 megohm.
 - 1. The portable reference electrode used for the test shall be calibrated against the standard electrode as specified in PERMANENT REFERENCE ELECTRODES.
 - 2. All test measurements and their locations shall be recorded.
- B. Adjusting: Final adjustment of the rectifier output current shall be made so that repeated voltage readings taken as specified for testing meet the criteria in CRITERIA OF PROTECTION.
- C. Placing in Service: After final adjustment, the cathodic protection system shall be placed in service and the condition of the system as left by Contractor shall be recorded and shall indicate voltage readings from reference electrode to tank; automatic control differential setting; ac supply voltage; adjusted dc output voltage; and total protective current.

3.7 QUALITY CONTROL: The Contractor shall establish and maintain quality control for operations under this section to assure compliance with contract requirements. The contractor shall maintain quality control records for all materials, equipment, and construction operations, including, but not limited to the following:

- A. Determination that all anodes are installed properly.
- B. Determination that all test stations are installed properly.
- C. Determination that all connections are made properly.
- D. Records of all tests and measurements.
- E. Records of all damage and defects and remedial measures for cathodic protection and the tank coating.
- F. Determination that all insulating joints are electrically isolating.

G. Determination that no contact exists between the protected system and other systems.

Seven copies of these records and Contractor tests, as well as the records of corrective action taken, shall be furnished to the Buyer.

END OF SECTION 16610

SECTION 16700

HEAT TRACING

PART I: GENERAL

Refer to Section 16010, Part I, for general requirements.

1.1 HEAT TRACING REQUIREMENTS:

- A. The Contractor shall provide all heat tracing cable, all accessories and completely install the entire heat tracing system so that it will provide complete freeze protection for all pipelines (including valves, flanges, etc.) described below and as shown on project drawings.
- B. Pipelines Heat Traced:
 - 1. All pipelines run exposed outdoors shall be heat traced.
 - 2. Vertical legs of buried pipelines shall be heat traced to approximately 5'0" below grade.
- C. Fluid in pipelines is basically water with limited quantity of contaminants.
- D. Approximate minimum water temperature desired is 50 degrees Fahrenheit.
- E. Minimum expected ambient temperature is minus 30 degrees Fahrenheit.
- F. All pipelines which are to be heat traced are made of either CPVC or polypropylene and are insulated as described in the appropriate specification sections of this Contract.
- G. The heat tracing system includes heat tracing cable, insulation sleeves, molded boots, insulation retainers, splice boxes, end seals, cable ties, fittings, supports, hardware, thermostats, and any other required components. All equipment shall be Chemelex Auto-Trace, as indicated, specified and required.
- H. Heat tracing cable shall be self-limiting type which automatically limits its own maximum temperature. Below maximum temperature, the heater shall regulate its own heat output. The built-in temperature control shall be accomplished by a semi-conductive heating material whose electrical resistance varies with its temperature.
- I. Heat tracing cable shall have two (2) No. 16 AWG copper bus wires, a self-regulating semi-conductive core, modified

polyolefin jacket, and a fluoropolymer outer jacket covering a tinned copper shield. Heat tracing cable shall be Chemelex Auto-Trace Type 5BTV1-CT with an output of 5.9 Watts per foot at 50 degrees Fahrenheit or an equivalent member of the "BTV1-CT family with required heat output for the application.

- J. Each heat tracing circuit shall operate at 120 V AC and 60 Hz. Control of all circuits shall be by an ambient sensing thermostat controller, Chemelex Type AMC-1A (BD). The thermostat controller shall activate a contactor in Panel P to allow energization of the heat tracing circuits. The thermostat controller shall become energized at a temperature of 40 degrees Fahrenheit.

K.

1. Each two (2) inch diameter pipeline shall be heat traced with at least one 5BTV1-CT cable attached to the pipe per standard Chemelex installation details.
2. Each four (4) inch diameter pipeline shall be heat traced with at least two 5BTV1-CT cables attached to the pipe per standard Chemelex installation details.
3. Flanges, valves, and supports shall be provided with the proper configuration of one or two 5BTV1-CT cables to maintain the 50 degrees Fahrenheit pipe fluid temperature. Heat tracing cable installation for flanges, valves, supports, etc. shall be per standard Chemelex installation details.

- L. Isometric Drawings and Details: Contractor shall furnish isometric drawings of the complete heat traced pipeline installation for this project. The drawings shall show clearly each heat traced pipe, the heater cable or cables used for each pipe, the designation of the circuit breaker supplying each heat tracing cable circuit, references to specific heater cable installation details for each pipeline valve, flange and support, and all junction boxes required to interface between heat tracing cable and power circuit cable.

Contractor's detailed design of the heat tracing system shall utilize a maximum of ten, 20 Amp, 120 VAC circuits to supply all heat tracing cable installed for the project pipelines.

Installation by the Contractor of heat tracing cable shall be based on approved isometric drawings.

- M. Labels reading "ELECTRIC TRACED" shall be installed on the outside insulation of all electrically heat traced piping.

The labels shall be placed at an interval of 20 feet or less so that they are readily visible.

N. Submittals

1. Submit for engineer's review all isometric drawings and details furnished for heat tracing system installation.
2. All calculations made for sizing required heat tracing cable for each pipeline run shall be provided for engineer's review.

PART II: PRODUCTS

2.1 MANUFACTURERS

Heat tracing equipment shall be Chemelex Auto-Tracer. :-

PART III: EXECUTION

Refer to Section 16010, Part III, for applicable requirements.

END OF SECTION 16700

SECTION 16770

LIFE SAFETY DISASTER WARNING SYSTEMS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

- A. The number of audible signaling devices and their placement is determined by sound pressure level (SPL) requirements, room dimensions, and anticipated occupancy. Contract drawings reflect these considerations and supply construction details.
- B. Where the term "horn" is used in these specifications, it shall be understood to refer specifically to a horn or re-entrant speaker.

1.2 REFERENCE STANDARDS

- A. Rocky Flats Plant Standard No.'s SE-501 and SE-701.

PART II: PRODUCTS

2.1 SPEAKERS

- A. Dual-voice coil speakers shall be Dukane Corporation, Catalog Item 5A451.
- B. Voice coil impedance shall be 8 ohms.
- C. Speaker wattage capability shall be 10 W.
- D. Speaker axial sensitivity shall be a minimum of 92 dB at 4 feet with 1 W input.
- E. Speaker frame shall be designed for easy installation of the impedance matching transformer with prepunched holes spaced at 2 3/8-in. centers.
- F. Speaker operating frequency shall be from 80 to 12,000 Hz.

2.2 TRANSFORMERS

- A. Line-matching transformers shall be Stancor, Catalog Item A-8102, or Dukane Corporation, Catalog Item 710-3090.
- B. Taps shall be provided at 8 W, 4 W, 2 W, 1 W, and 1/2 W to an 8 ohm speaker on a 70-V distribution line.
- C. The transformer's mounting holes shall be 0.187 in. in diameter and spaced 2 3/8 in. between centers.

- 2.3 BACK BOXES: Suspended, ceiling-mounted speakers shall be accompanied by back boxes as supplied by Dukane Corporation, Catalog Item 145-226-LS.
- 2.4 GRILLE, CEILING-MOUNTED: Suspended, ceiling-mounted baffles shall be Dukane Corporation, Catalog Item 6A335, or approved equal.
- 2.5 HORNS
- A. Horns shall be Dukane Corporation, Catalog Item 5A410, or Atlas Sound, Catalog Item APC-30T.
 - B. Built-in transformers shall be included with wattage taps of 1.8 W, 3.7 W, 7.5 W, 15 W, and 30 W on a 70-V distribution line.
 - C. The sound pressure rating shall be 123 dB (at 4 feet with 30 W tap).
- 2.6 SPEAKER WIRING
- A. Speaker Distribution Cable--Speaker and amplifier interconnection shall be made with two-conductor, 18 American wire gage (AWG), 16 x 30 stranded wire, Belden Corporation, Catalog Item 9740, or approved equal.
 - B. Supervisory Distribution Cable--Install to all speakers, but do not connect.
- 2.7 HEAD END EQUIPMENT
- A. Amplifier--Amplifier shall be 35 W, 70-V output, Dukane Catalog 1A1635. Amplifier shall be mounted in a NEMA 12 Hoffman model A-242008LP Box with an A-24P20 panel. Install two A-VK64 louvers-one on each side near top of box.

PART III: EXECUTION

3.1 GENERAL

- A. Wiring methods shall comply with National Electrical Code (NEC) Articles 300 and 640.
- B. Terminations and splices shall be made in accordance with NEC Article 110-14.
- C. Crimp-type, ring-tongue connectors shall be used at device terminals, except where box-lug, pressure-plate, or solder terminals are provided.

3.2 SPEAKER INSTALLATION

- A. Speakers shall be ceiling-mounted where feasible and wall-mounted otherwise.
- B. Speakers and horns shall be positioned and wired as shown on the drawings. Care shall be taken to ensure that each wire of the distribution cable is connected to the same terminal of all speakers or horns to provide correct phasing.
- C. Speakers and horns mounted on opposite room walls shall not directly face one another.
- D. Speakers shall be tapped at 2 W except as noted on drawings.
- E. Horns shall be tapped at 7.5 W except as noted on drawings.

3.3 AMPLIFIER INSTALLATION

- A. Amplifier shall be attached to the panel by four machine screws. Screws shall be installed through holes to be drilled in the panel through the rubber feet on the bottom of the amplifier.
- B. The Seller shall pre-assemble the panel, amplifier, terminal strip, and wiring between the components before installing the panel in the enclosure. The duplex receptacle shall be installed after the panel is in place.
- C. The Seller shall label the amplifier knobs and switches using Dymo labels.
- D. The Seller shall provide a nameplate on the enclosure cover. nameplate shall be 1-3/4" by 5" by 1/16" thick black laminated duralite. Letters shall be 1/2" high, white, and indicate Plant Warning System."
- E. The Seller shall make no connections to voice Coil #2.
- F. The Seller shall provide and connect a 3/4" conduit with two (2) #12 THWN + one (1) #12 GRND to the distribution panelboard.

PART IV: TESTING

4.1 GENERAL

- A. All PWS components shall be tested by the Contractor in the presence of the Buyer to verify:
 - 1. Equipment performance per specifications;
 - 2. High quality of construction; and

3. Installation according to design drawings.

B. The following procedure shall be used and comments noted. The Contractor's and Buyer's representatives shall sign as noted at the end of this procedure.

C. Component Checkout Test

1. Manufacturer and model numbers of head-end equipment and enclosure comply with specifications, design drawings, and approved submittals.

PASS _____ FAIL _____ COMMENTS _____

2. Head-end equipment wiring is neatly routed and bundled. Terminations are tight and the specified connectors are used.

PASS _____ FAIL _____ COMMENTS _____

3. Equipment and terminal block location and connections agree with design drawings or as-built red-lines.

PASS _____ FAIL _____ COMMENTS _____

4. Verify that each speaker and horn is located according to design drawings.

PASS _____ FAIL _____ COMMENTS _____

5. Check each speaker or horn for correctness of connections, hardware used, and installation. This should be done at rough-in stage of construction.

PASS _____ FAIL _____ COMMENTS _____

6. One set of red-lined designed drawings shall be delivered to the Buyer that document all changes to original design. These drawings shall be clearly legible and in good condition.

PASS _____ FAIL _____ COMMENTS _____

7. The Plant Warning System was tested in my presence and according to this procedure.

- a. Testing is incomplete and will be continued when failures have been corrected:

Facilities
Engineering (FE) _____ Date _____

Construction
Coordination _____ Date _____

Contractor's
Representative _____ Date _____

- b. Testing is complete and the PWS is accepted:

FE _____ Date _____

CC _____ Date _____

CR _____ Date _____

END OF SECTION 16770

SECTION 17000

GENERAL INSTRUMENTATION, CONTROL AND MONITORING REQUIREMENTS

PART I: GENERAL

1.1 DESCRIPTION

ICM Specifications Section 17000 through 17999 are hereinafter called the ICM Sections. This Section covers the general requirements for furnishing and installation of all instrumentation, control and monitoring (ICM) systems complete in every detail for the purposes specified and shall form a part of all ICM Sections of Division 17 unless otherwise specified. Other ICM Sections shall supplement this Section as necessary.

A. Work Included in the ICM Section of Division 17. Instrumentation work as indicated, specified, and required. The intent of the ICM Sections of Division 17 is to require that the complete Instrumentation, Control and monitoring System, i.e., primary elements, panel mounted and miscellaneous field instruments, etc. shall be furnished by a single ICM Subcontractor to assure system uniformity, subsystem compatibility and coordination of all system interfaces. Deviations may be considered in special circumstances but must be approved by the Buyer.

1. Furnish all tools, equipment, materials, and supplies and perform all labor required to complete the furnishing and installation of, including all instrumentation signal and power conduit and wiring not specifically shown on the electrical drawings, validation, start-up and operational testing of a complete and operable Instrumentation, Control and Monitoring System as indicated on the Drawings and as specified herein.
2. Provide all the necessary equipment components and interconnections and the services of the manufacturers' engineering representatives for the engineering, implementation, start-up, operation and instruction, to insure that the Buyer receives a completely integrated and operational ICM as herein specified.

B. Related Work Specified Elsewhere

1. Process piping, installation of in-line instrumentation, i.e., primary and final control elements in process pipelines, and miscellaneous mechanical work as specified elsewhere in this Specification.

2. Electrical power distribution specifically included under Division 16, circuit protection devices, instrumentation signal and power conduit and wiring indicated, and miscellaneous electrical requirements as specified in Division 16.

1.2 SYSTEM RESPONSIBILITY

Contractor's attention is directed to the fact that the ICM system as specified in these ICM Sections of Division 17 is an integrated system and therefore shall be provided by a single competent, qualified instrumentation Subcontractor (hereinafter referred to in these ICM Sections as the ICM Subcontractor) who shall have total responsibility for the work of this Division. Entire system installation including calibration, validation, start-up, operational testing, and training shall be performed by qualified personnel, possessing all the necessary equipment and who have had experience performing similar installations. The System shall be integrated using the Subcontractor's latest, most modern proven design and shall, as far as practical, be of one manufacturer. Overall system performance shall be guaranteed by the specified ICM Subcontractor.

- A. The Contractor shall subcontract the work under these ICM Sections to a qualified ICM Subcontractor who shall perform said work but it shall be understood that this shall not relieve the Contractor from any responsibility under the Contract. Although many references made herein are to work requirements and responsibilities of the ICM Subcontractor such references shall only mean that responsibility shall pass through the ICM Subcontractor but in the final analysis shall rest with the Contractor.
- B. The ICM Subcontractor shall be responsible for the correct installation of all hardware and systems specified in these ICM Sections. Certain Primary elements, Final Control Elements, etc., although provided as part of this Division, shall be installed in the process lines under other Divisions of these Specifications; however, this installation shall be under the direct supervision of the ICM Subcontractor.
- C. The ICM Subcontractor shall be responsible to see that all components of the instrumentation system, including primary measuring, indicating, transmitting, receiving, recording, totalizing, controlling, and alarming devices and all appurtenances, are completely compatible and shall function as outlined and he shall furnish and install such additional equipment, accessories, etc. as are necessary to meet these objectives at no cost to the Buyer.

1.3 QUALITY ASSURANCE

- A. Qualification And Manufacturers. The ICM subcontractor shall be a recognized PLC systems integrator, a panel fabricator, and installer of field instruments. The ICM subcontractor's place of business shall be within a 200 mile radius of the jobsite, and the ICM subcontractor shall have been in business at that location for a minimum of five years. The ICM Subcontractor shall have a minimum of 10 years documented experience in providing ICM equipment on a single system responsibility basis for municipal water and wastewater treatment processes. Also, the personnel employed for system engineering, supervision, start-up, operational testing and training shall be regular employees of the ICM Subcontractor. The ICM Subcontractor shall be fully responsible for the technical supervision of the installation to ensure that it is proper in all respects.
- B. Certification By Single ICM Subcontractor. At the time of quoting to prospective Contractor prior to bid opening, each prospective single ICM Subcontractor shall execute and submit a written certification of intent to assume full responsibility for the complete requirements of all ICM Sections.

Each prospective Contractor shall include with his proposal the certification required above for the proposed single ICM Subcontractor. Each certification shall be as included in the proposal form, it shall be signed by his authorized responsible representative, and it shall include the following statement:

" _____ (Corporate name of Subcontractor) _____
hereby certifies intent to assume and execute full responsibility to select, to furnish, to supervise installation and connection, to test, calibrate, validate, and place into operation, all meters, instruments, alarm equipment, control panels, and all other assemblies, components, and accessories needed to place into service complete operating process control systems, all in full compliance with the requirements of all ICM Sections.

"In addition, it is certified that drawings and data will be prepared and submitted, specified field services will be performed by qualified personnel, operating personnel will be instructed, and technical manuals will be prepared and submitted, and as required by the ICM Sections.

"Finally, it is certified that the quotation offered provides for full and complete compliance with the requirements of the ICM Sections of Division 13 without exception."

- C. Standard of Quality. Furnish equipment of the types and sized specified which has been demonstrated to operate successfully. Wherever on the Drawings and in these Specifications, materials or equipment have been specified by using the name of products or manufacturers, the term "or approved equal" is always understood to follow immediately. Material or equipment, so specified, have been selected as being most suitable and are regarded as a standard and are not intended to eliminate others of equal quality and performance. The order of listed manufacturers shall not be construed as a preference "or order of quality. Workmanship for the installation of instruments, wiring, piping, painting and labeling shall be equal to the best industrial standards for instrumentation and control work.

All electrical equipment and materials, including their installation, shall conform to Division 16 unless specified otherwise in this Division.

- D. Factory Inspection. Buyer or his representative may inspect fabricated equipment at the factory. Notify Buyer in sufficient time so that factory inspection can be arranged. Factory inspection shall be made only after manufacturer has performed satisfactory checks, adjustments, tests and operations. Tests shall be made using simulated inputs and output loads. Approval of equipment at the factory only allows the manufacturer to ship the equipment to the site, and does not constitute final acceptance by Buyer.

The Buyer will indicate on return of the approved submittal each item requiring factory inspection. Lack of such indication by the Buyer shall constitute a waiver of factory inspection.

1.4 DRAWINGS

- A. Information on the Drawings. The following information relative to the work of the ICM Sections is indicated on the Drawings.
1. Location of all primary elements, control panels, and final control elements.
 2. Instrumentation signal and power conduit runs between control panels and field instruments and devices.
 3. Quantity and sizes of instrumentation conductors and cables are indicated on the drawings, but shall be verified by the ICM Subcontractor.
 4. Location of all equipment having alarm and equipment status contacts.

5. Major instrument conduit runs.
 6. General control room and control panel layouts.
- B. Information Not Shown On The Drawings. The following information relative to the work of the ICM Sections may not be shown on the Drawings, but shall be the responsibility of the ICM Subcontractor to determine, furnish, coordinate with other Divisions, and submit for approval, based upon the systems specified.
1. Tubing for hydraulic and pneumatic signals and/or power between main headers and control panels, field mounted primary elements, field instruments and final control elements.
 2. Number or sizes of tubing required for all pneumatic, and hydraulic signals.
 3. Point of connection to any hydraulic or pneumatic supply lines.
 4. Detailed control panel layouts.

1.5 SUBMITTALS

Refer to Division 1 for required method of preparation and transmittal, and conform to requirements herein.

- A. Presubmittal Conference. Arrange a conference between the ICM Subcontractor and the Buyer or his representative within sixty (60) days after award of the Contract for the purpose of informally discussing in detail and verifying the correctness of the ICM Subcontractor's system engineering methods and equipment and to generally provide a framework for communication and coordination. This conference shall be attended by ICM Subcontractor's Engineer, and duly authorized representatives of the Contractor and Buyer.

Prepare a draft of the submittal for review. The draft shall include the following, as a minimum:

Listing of major items proposed for this Division. Identify items by tag number, description, function, manufacturer, model number, descriptive literature and statement as to whether item is "as specified or equivalent". Items identified as "equivalent" shall be accompanied by a comparative listing of the published specifications for the item specified and for the item proposed.

- B. Shop Drawings. Before proceeding with any manufacturing, submit Shop Drawings for approval in complete bound sets indexed by specification number. Describe the items being submitted. Manufacturer's specification or data sheets shall be clearly marked to delineate the options or styles to be furnished. Submit only complete systems, not pieces of equipment from various systems. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Schematics shall be complete with tag and terminal numbers. Submit fabrication drawings, nameplate legends, and control panel internal wiring and piping schematic drawings clearly showing all equipment and tag numbers on all panels. Submit panel graphic drawings where applicable. Include material specifications lists where applicable. Include a draft of the theory of operation for all relay logic circuits including those implemented via programmable controllers, to be included in the instruction manual required below.

Submit an "Equipment Specification Data" form for each item equipment which shall summarize the specification features as called for in these Specifications and include other necessary data as would provide a complete and adequate specification for reordering an exact duplicate of the original item from the manufacturer at some future date. The assigned tag numbers and manufacturer's part numbers shall be included but will not be considered as a substitute for any of the required statement of specifications. More than one tag numbered item may be included on a sheet.

- C. Loop Diagrams. Prepare and submit instrumentation loop diagrams for all work included in the ICM Sections in accordance with Instrument Society of America Standard 15A-S5.4.
- D. Record Drawings. Contractor shall submit reproducibles of complete schematics, wiring diagrams and installation drawings to include all installed field and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details, point to point diagrams with a cable, wire, tube and termination numbers. Drawings shall be a record of work as actually constructed and shall be labeled as "Record". One copy of applicable schematics and diagrams shall be placed in each control panel in a protective envelope or binder.
- E. Instruction Manuals. Furnish six (6) sets of Instruction Manuals and Pat Lists for instrumentation equipment provided under the ICM Sections. Obtain distribution method instructions from Buyer or his representative.

1. Schedule. Deliver two (2) copies of manuals not later than the equipment shipment date. After installation is complete, update the manuals to reflect any changes which occurred during installation and deliver balance of manuals to Buyer.
2. Contents. Include in the manuals not less than the following information, as applicable, for each instrument, equipment, subsystem and/or control loop:
 - a. General introduction and overall description, purpose, functions, simplified theory of operations, etc.
 - b. Specifications (including equipment specification data sheet as described above under Shop Drawings).
 - c. Installation instructions, procedures, sequences, tolerances, and precautions.
 - d. Operational procedures.
 - e. Shut-down procedures.
 - f. Maintenance, calibration, and troubleshooting instructions.
 - g. Schematics and wiring diagrams.
 - h. Detailed circuit operational description including annotated programmable controller ladder diagrams.
 - i. Parts list and spare parts recommendations.
3. Format. Use drawings and pictorials to illustrate the text to the extent necessary to ensure a clear, concise presentation. If manuals have been written to cover a family of similar instruments or equipments, strike out inapplicable information in a neat fashion or emphasize applicable portion by heavily weighted arrows, circles or boxes; whichever provides the clearest and neatest presentation. Where identical instruments are used in more than one control loop or subsystem, include only one instruction manual; however, an index by tag number for all instruments shall identify its location in that manual.

Control loop and/or subsystem operational descriptions shall identify the function of each instrument and its relation to the other instruments in the loop.

4. Binding. Bind each manual in a cover which indicates the system name, manufacturer's name, local address and telephone number, and year of purchase. Punch and bind manuals in standard three ring binders and include system name and ICM Subcontractor's name on binding.
- F. ICM Subcontractor's Certified Reports. The ICM Subcontractor, or his authorized representative, shall submit a certified report for each control panel and associated field instruments certifying that the equipment (1) had been properly installed under his supervision, (2) is in accurate calibration, (3) was placed in operation in his presence, (4) has been checked, inspected, calibrated, and adjusted as necessary, (5) has been operated under maximum power variation conditions and operated satisfactorily, and (6) is fully covered under the terms of the guarantee.
- G. Demonstration And Final Operating Test Plans And Results. Submit for approval not later than 30 days prior to the test demonstration, a written plan for demonstrating that each system of equipment provided under the ICM Sections meets the specified operational requirements. The plan shall include procedures to be used in final operation testing of entire systems including a description for each system of test methods and materials, testing instruments and recorders, a list of the equipment involved with the functional parameters to be recorded on each item, and shop drawings of required temporary by-passes and like facilities. Submit three copies of test results and records for all final operation tests.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repair any damage as directed and approved.

1.7 JOB CONDITIONS

Drawings are diagrammatic and show the intended arrangement for system operation, piping, and appurtenances. Conform to Drawings as closely as possible and exercise care (1) to secure neat arrangement of piping, valves, conduit, and like items, and (2) to overcome structural interferences. Verify dimensions and conditions at the place of work, and install materials and equipment in the available spaces.

1.8 GUARANTEE AND WARRANTIES

Guarantee all work of the ICM Sections in accordance with the Conditions of Contract and Division 1. With respect to instruments and equipments, guarantee shall cover (a) faulty or inadequate design; (b) improper assembly or erection; (c) defective workmanship or materials; and (d) leakage, breakage, or other failure not caused by Buyer misuse. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty to Buyer with Buyer named as beneficiary.

1.9 ACCESSORY AND MAINTENANCE MATERIALS

Furnish the following items as specified herein. Deliver to Buyer, as directed, with itemized list in a letter of transmittal accompanying each shipment.

- A. Special Tools And Accessories. Furnish special tools, instruments, and accessories for maintaining instruments and equipment requiring periodic repair and adjustment as specified elsewhere herein. Also, furnish special lifting and handling devices for equipment requiring such devices.
- B. Maintenance Materials And Spare Parts. Deliver in manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished.

Spare parts shall consist of the following basic items:

- 1. Five (5) percent but not less than one (1) minimum of each type of plug-in unit, etched or printed circuit board assembly.
- 2. Ten (10) percent but not less than one (1) of each type recorder chart drive mechanism installed.
- 3. Ten (10) percent but not less than one (1) of each type relay and timer used.
- 4. Ten (10) percent but not less than one (1) of each type switch used.
- 5. Ten (10) percent but not less than six (6) of each type light bulb and fuse used.
- 6. Minimum of one (10) year supply of expendable items, such as charts, ink, ribbons, etc.

PART II: PRODUCTS

2.1 MATERIALS AND STANDARD SPECIFICATIONS

Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as ANSI, ASTM, ISA, and SAMA. The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the plant; i.e. all instruments in the plant, supplied by the ICM Subcontractor, of the same type shall be by the same manufacturer. This allows the stocking of the minimum number of spare parts.

2.2 STRUCTURAL STEEL FABRICATIONS

Design all fabrications for dynamic and vibratory loadings. Use structural steel shapes conforming to ASTM A36, A500, A501, A570, A618, or equal, as applicable. Conform welding to AWS D2.0 Code. Galvanize specific items in accordance with ASTM A123 or A386 as applicable: use galvanized bolts and fasteners with galvanized assemblies. Use minimum 1/4" thickness for steel entirely or partially submerged during equipment operation. Submit design calculations showing adequate structural integrity for the intended purpose.

2.3 MOUNTINGS

Mount and install equipment as indicated. Where not shown, mount field instruments according to best standard practice on pipe mounts, pedestal mounts, or other similar means in accordance with supplier's recommendation. Where mounted in control panels, mount according to requirements of that Section.

Equipment specified for field mounting shall be suitable for direct pipe mounting, pedestal mounting, or surface mounting and non in-line indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than three (3) feet nor higher than five (5) feet above walkways, platforms, catwalks, etc. All such equipment shall be weather and splash proof, and electrical equipment shall be in NEMA 4 cases. If mounted in a designated hazardous area, the equipment shall be explosion proof or rated intrinsically safe, whether so specified herein or not.

2.4 INSTRUMENT IDENTIFICATION

All major instrumentation and equipment items or systems specified in the ICM Sections are identified by system and tag numbers. This same number appears in the tag number designations on the Drawings and on the schedules of these Specifications. All instrumentation and equipment shall be identified by nameplates and/or tags. Nameplates for panels and panel mounted equipment shall be as

specified under Panels and Control Room Hardware. Field equipment shall be tagged with assigned instrumentation tag number and function. Tags shall be black lamacoid with engraved white characters of 3/16 inch minimum height. Tags shall be attached to equipment with a commercial tag holder using a stainless steel band with a worm screw clamping device or by a holder fabricated with standard hose clamps and meeting the same description. In some cases where this would be impractical, use 20 gauge stainless steel wire. For field panels or large equipment cases use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part. In all cases the tag shall be plainly visible to a standing observer. In addition to tags, field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed. Nameplate shall be attached by one of the above methods.

2.5 ELECTRONIC EQUIPMENT

If the equipment is electronic in nature, provide solid state equipment to the extent practicable. Select components of construction for their suitability and reliability. Employ adequate component derating to preclude failures because of transients and momentary overloads reasonably expected in normal operation. Design units for operation without forced cooling, unless such cooling is an integral part of the device.

2.6 EQUIPMENT OPERATING CONDITIONS

All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum range:

A. Power

1. Electrical. 120 Vac \pm 10%, 60 Hz \pm 1 Hz except where specifically stated otherwise on the drawings or in the specifications.
2. Air. 20 psig \pm 1 psig.

B. Field Instruments

1. Outdoor Areas:
Ambient Temperature: -15°F to 120°F
Ambient Relative Humidity: 5% to 100%
Weather: Rain, sleet, snow, ice, wind, sun and blowing sand.
Provide, as necessary, enclosures, sunshields, thermostatically controlled heaters, etc. to assure normal operations under these conditions.

2. Indoor Unheated Areas.
Ambient Temperature: 5°F to 120°F
Ambient Relative Humidity: 5% to 100%
3. Indoor Environmentally Controlled Areas:
Ambient Temperature: 50°F to 95°F
Ambient Relative Humidity: 5% to 100%

2.7 POWER SUPPLIES

Provide electrical instruments and control devices for operation on 120 Vac, 60 Hz current. This requirement is to prevent total loss of control because of the failure of a common DC power supply. this requirement will be waived upon demonstration to the satisfaction of the Buyer that the ICM Subcontractor shall install dual DC power supplies in each panel with automatic failure detection and annunciation and witch over without loss of control functions. These dual power supplies shall be totally independent with all solid state rectifiers, regulators, failure sensing (with front of panel indication), and output switching. Source of operating power shall be 120 Vac, 60 Hz commercial power. Units shall be rack mounted within the control panels.

2.8 SIGNAL ISOLATORS, CONVERTERS AND CONDITIONERS

Insure that input-output signals of all instruments and control devices (whether furnished by the ICM Subcontractor or not) are compatible. Unless otherwise specified signals between field and panels shall be 4 to 20 mAdc unless specifically approved otherwise. Granting such approval does not relieve the ICM Subcontractor from the compatibility requirement above. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices behind control panels or in the field at point of application. provide items as manufactured by ACM Electronics, Moore Industries, or Rochester Instrument Systems.

2.9 AUXILIARY CONTACTS BY OTHERS

Provide instruments and equipment to connect to auxiliary contacts provided by others for alarms, status of equipment, interlocking, and other functions as indicated and as specified herein.

2.10 AIR SUPPLY VALVES

Provide valves for instrument air supply shutoff, regulating, switching, metering, valve manifolds, etc., equal to valves manufactured by Whitey Company, Nupro Company, Hoke Inc., or equal.

2.11 INSTRUMENT PIPING

Provide instrument air and instrument pneumatic piping, as specified in other Divisions and as necessary and/or as specified herein. Instrument air header shall be furnished and installed under other Divisions. Connect to main instrument air header at a point not more than ten (10) feet distant from air consuming device(s). Use 1/2 inch minimum 316 stainless steel tubing. All connections to equipment shall be made with separable or union type fittings and shall include shut-off valves. All hydraulic and/or pneumatic piping shall be tested for leaks prior to placing the system in operation. Provide instrument pneumatic air fittings, with double ferrule, which shall be Swagelok manufactured by Crawford Fitting Company, Cajon manufactured by Cajon Company, Gyrolok by Hoke Inc.

2.12 FILTER REGULATOR

Furnish a filter-regulator and discharge Pressure gauge furnished with a dripwell assembly for each point of use where regulated instrument air is required. Separate regulators shall be used for each control loop. Regulators shall be Fisher 67FR, or Musoneilan 80-4.

2.13 MANIFOLDS

Furnish an integral three-valve manifold for each differential pressure transmitter on a flow application. Manifolds shall be equal to Anderson-Greenwood M-4A, Hoke, or Swagelok.

2.14 PAINTING

Provide factory paint for all instruments and equipment except where in pipelines. Provide paint as required in Division 9 for structural supports, brackets, etc.

2.15 ELECTRICAL

- A. The construction work shall include all the power supply wiring, instrumentation wiring, interconnecting wiring and equipment grounding as indicated, specified and required and not specifically included under Division 16.
- B. Wiring installations shall include cables, conductors, terminals connectors, wire markers, conduits, conduit fittings, supports, hardware and all other required materials not specifically included in the work of other Divisions.
- C. Provide the materials and complete all the required installations for equipment grounding as specified in Division 16 of these Specifications, and indicated on the Electrical Drawings.

- D. Incidental items, not specifically included in the Contract Documents, that can legitimately and reasonably be inferred to belong in the instrumentation work shall be provided by the ICM Subcontractor.
- E. Field Wiring. For wiring materials, refer to Division 16 and Details on the Electrical Drawings. Ring out signal wiring prior to termination. Provide wire number tags marked in indelible waterproof form of slip-on type or equal for each termination. Provide pre-insulated crimp-on connectors for wire terminations and splices. Use ratchet type crimping tool which does not release until proper crimp pressure has been applied.
- F. A minimum specification of 9" is required between signal wires and power wiring.

2.16 PROCESS CONNECTIONS

Piping, tubing, and capillary tubing shall be 316 stainless steel. If this material is unsuitable for ambient or process conditions, piping and tubing shall be of a material approved by Buyer. Slope lines according to service to promote self draining or venting back to the process. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shut down of the process. Include drip legs and blow-down valves for terminations of sense lines at the instruments when connecting fittings, an block valves shall be furnished and installed under other Divisions of these Specifications but coordinated by the ICM Sections. Instrument process taps shall be a minimum 3/4-inch NPT except flowmeter taps which shall be 1/2-inch NPT. Provide Anderson Greenwood gauge valves part number M5VHS-46 with a part number H7VS-44a bleed valve for 3/4-inch taps. For 1/2-inch flowmeter taps the gauge valves shall be part number M5VHS-44 with a H7VS-44Q bleed valve.

PART III: EXECUTION

3.1 INSPECTION

Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of instruments and equipment.

3.2 PREPARATION

Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing instruments

and equipment. Maintain the areas in a broom-clean condition during installation operations.

3.3 FACTORY TESTING OF CONTROL PANELS

Verify, at the factory, wiring continuity and verify panel operation by simulated inputs and outputs. Provide report certifying the control panels are operable and meet the Specifications.

3.4 MANUFACTURERS' INSTALLATION AND SUPERVISION

When specified in Sections 17100, 17200 and 17300, furnish the services of authorized factory personnel especially trained and experienced in the installation of the equipment to: (1) supervise the installation in accordance with the approved Instruction Manual; (2) be present when the instruments and equipment are first put into operation; (3) inspect, check, adjust as necessary, and approve the installation; (4) calibrate the instruments, in accordance with the Specifications herein, until all trouble or defects are corrected and the installation and operation are acceptable; and (5) prepare and submit the specified Manufacturers' Certified Report. Include all costs for representative's services in the Contract Price.

3.5 INSTRUMENT CALIBRATION

Provide the services of trained and experienced instrumentation technicians, tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications and instructions for Calibration. Each instrument shall be calibrated at 10 percent, 50 percent and 90 percent of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated. Such test instruments shall have accuracies traceable to the National Bureau of Standards, as applicable. provide a list and basic specifications for instruments used. Provide a written report to the Buyer on each instrument certifying that it has been calibrated to its published specified accuracy. This report shall include all applicable data as listed below plus any defects noted, corrective action required, and correction made. Data shall be recorded on prepared forms and shall include not less than the following items.

- (1) Facility identification (Name, location, etc.).
- (2) Loop identification (Name or function).
- (3) Equipment tag and serial numbers.
- (4) Scale Ranges and units.
- (5) Test mode or type of test.
- (6) Input values or settings.
- (7) Expected outputs and tolerances.
- (8) Actual readings.

- (9) Explanations or special notes as applicable.
- (10) Tester's certification with name and signature.

3.6 SYSTEM VALIDATION

Provide the service of trained and field experienced instrumentation engineer(s) to validate each system to verify that each system is operational and performing its intended function within system tolerance. System tolerance is defined as the root-mean-square sum of the system component published specified accuracies from input to output. Validate each system by simulating inputs at the first element in loop (i.e. sensor) of 10 percent, 50 percent, and 90 percent of span, or on/off and verifying loop output devices (i.e. recorder, indicator, alarm, etc. except controllers). During system validation, make provisional settings on levels, alarms, etc. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point. Verify that all logic sequences operate in accordance with the specifications.

Cause malfunctions to sound alarms or switch to standby to check system operation. Check all systems thoroughly for correct operation. Test equipment for this function shall be as specified under "Instrument Calibration".

Immediately correct all defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest. Provide a report certifying completion of validation of each instrument system. This report shall indicate calculated system tolerances, data verifying that the system meets these tolerances, and any provisional settings made to devices. Data sheets shall be similar to those used for Calibration.

3.7 FINAL OPERATIONAL TESTING AND ACCEPTANCE

Upon completion of instrument calibration and system validation, test all systems under process conditions. The intent of this test is to demonstrate and verify the operational interrelationship of the instrumentation systems. This testing shall include, but not be limited to, all specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and/or mechanical equipment.

Immediately correct defects and malfunctions with approved methods and materials in each case and repeat the testing. Upon completion of final operational testing, submit certified report, with substantiating data sheets, indicating that total ICM System meets all the functional requirements specified herein. The Buyer will countersign this report and it shall constitute final acceptance of the ICM System.

Testing shall be observed by the Buyer. Notify the Buyer in writing a minimum of 48 hours prior to the proposed date for commencing the test. Upon completion of this test the Contractor shall begin or have begun system start-up. Buyer reserves the right to set the schedule.

3.8 START-UP ASSISTANCE

When specified in Section 17100, 17200 and 17300, provide the services of a factory trained and field experienced instrumentation engineer to assist Buyer's personnel during startup of the system. Purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

3.9 INSTRUCTION OF BUYER'S PERSONNEL

Provide the services of a trained and field experienced instrumentation engineer to conduct group training of Buyer's designated personnel in the operation of each instrument system. This training shall be for a minimum time period of 3 days, one day of which may be performed during the operational testing period. Obtain Buyer's written consent that the training has been adequate. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the single line loop system drawings, P&IDs, I-Drawings, and operation and maintenance manuals furnished under these Specifications.

END OF SECTION 17000

SECTION 17050

INSTRUMENTATION, CONTROL AND MONITORING SYSTEM DESCRIPTION

PART I: GENERAL REQUIREMENTS

- 1.1 DESCRIPTION: This Section describes the Instrumentation, Control and Monitoring (ICM) System for the 881 Hillside treatment facility. It is the intent of this Section to also supplement, where applicable, other Sections of Division 17. Certain systems described are supplied as package systems or Government Furnished Equipment (GFE) discussed under other Sections by the Buyer, and are so identified. This Section briefly describes each system in order that the ICM subcontractor, as well as the suppliers of GFE and other package systems, shall be aware of the magnitude of the total ICM system.

The 881 Hillside treatment facility consists of a series of remote ground water collection and transmission systems and a central treatment facility located in Building 891. The collection facilities include a collection well and three sumps located at low points in a french drain. Submersible pumps are used to transfer the collected ground water to 15,000 gallon influent storage tanks D-201 or D-202. The tank to be filled shall be manually selected by the operator through a valve line-up.

Water from D-201 or D-202 is fed to an ultraviolet (UV)/hydrogen peroxide (peroxide) treatment unit (provided as GFE by the Buyer) by transfer pumps P-301 and P-302. Flow from the UV/peroxide system is collected in 15,000 gallon ion exchange storage tank D-203 and processed through an ion exchange treatment unit (provided as GFE by the Buyer). Flow from the ion exchange unit is directed to 110,000 gallon effluent storage tanks D-205, D-206, or D-207.

The ion exchange treatment unit requires four Contractor-supplied ancillary systems. The bulk caustic storage system includes 1,250 gallon storage tank D-208 and associated valves and controls. The bulk acid storage system includes 2,500 gallon storage tank D-209 and associated valves and controls. The neutralization system collects spent regenerant and slow rinse solutions in 5,000 gallon tank D-210 for pretreatment and transfer to final treatment and disposal. Finally, the clean water storage system provides storage for treated effluent in 15,000 gallon storage tank D-204. This water is used in the ion exchange treatment unit for backwashing, chemical dilution, and rinsing.

1.2 PROCESS INSTRUMENTATION, CONTROL & MONITORING FUNCTIONS

The overall function of the Instrumentation, Control, and Monitoring System shall be to provide an efficient control and monitoring interface between plant operations and treatment processes by

presenting visual and audible information of plant operating parameters, equipment status and wear, and alarm conditions. It provides automatic control of critical parameters or parameters which would require frequent operator attention. The systems shall provide means for manual override operation of any automatic function when required and shall permit control of the operation of motors and valves that are pertinent to satisfactory process performance. The system shall provide the following described functions in accordance with the process and instrumentation diagrams ("I"-Drawings).

- A. Included herein are functional descriptions of the process instrumentation and control systems which specify the responsibility of the Process Instrumentation, Control & Monitoring System Supplier. These descriptions are to supplement the Process and Instrumentation Drawings and neither is complete without the other. If the ICM Subcontractor requires devices other than shown on the Drawings and/or specified herein to achieve the result required by the system description, provide these devices to obtain the required result.
- B. The intent of these Specifications is to secure systems that have 4-20 mAdc analog signals between control panels and field devices throughout the plant except where specified otherwise.
- C. The systems descriptions herein cover all processes in general even though no specific ICM work is required in a given system. These descriptions are provided for completeness and to indicate the relationship of the ICM work to other divisions. Where specific functions are described as to be performed under the Electrical Division they shall be as binding upon the Contractor as if written in the Electrical Division Sections.

1.3 SYSTEM DESIGNATIONS

The Drawings and system descriptions are divided by system designations as shown on the Drawings. All equipment numbers utilizing these designations and systems are described in the indicated order. In the following descriptions, where no ambiguity should result from dropping a portion of the designation prefixes, the numbers will be abbreviated for convenience. Hyphens in numbers may be omitted unless required to distinguish between two otherwise similar numbers such as FV11-1 and FV1-11. Hyphens in designations on the drawings have no significance other than to distinguish between letters and numerals or to otherwise increase clarity. Refer to Drawing 38548-005 for a complete listing of abbreviations and symbols.

- A. Instrumentation, Control, And Monitoring Philosophy. The instrumentation, control and monitoring equipment for the 881 Hillside treatment facility, as described herein, is based on providing sufficient measurement, indication and/or automatic

control to enable process operation within the design criteria. Automatic control loops are specified only where necessary, and include manual bypass control options. Adequate monitoring equipment is specified to permit complete process operational management and evaluation and for operator protection. In general, automatic controls are confined to level, time, temperature, flow, and flow direction. Other more sophisticated controls may be included in some packaged systems.

The overall ICM philosophy includes both local automatic control of some systems at a field panel (FP), as well as overall automatic control and monitoring by a programmable logic controller (PLC) located in the main control panel (MCP). Except as noted, all analog inputs, status, and alarm signals shall be connected to the appropriate PLC I/O in the MCP as shown on the Drawings. All controller functions, receiver switch functions, alarm functions, and annunciator functions shall be performed by the PLC. All external telemetry shall be performed by the PLC as well.

B. Automatic Motor Control

1. Automatic Operation. Except when specifically described otherwise, all motors specified for automatic operation shall be provided with HAND-OFF-AUTO (H-O-A) selector switches. In the HAND position, the motor shall operate continuously and automatic interlock, if any, shall be bypassed. In the OFF position, the motor shall be stopped. In the AUTO position, operation of the motor shall be dependent on the status of the output contact of the control circuit to be described for the individual equipment.
2. Automatic Standby Operation. When specified for automatic standby, motors in multiple unit systems shall also be provided with either a DUTY-STANDBY (D-S) selector for automatic motors with H-O-A switches or HAND-OFF-STANDBY (H-O-S) switches for manually operated motors without H-O-A switches.
 - a. Automatic motors with selectors on AUTO and DUTY shall be controlled by the automatic control circuit, those selected for AUTO and STANDBY shall operate only if a DUTY motor fails to respond.
 - b. The standby function shall be inoperative when the H-O-A selector is in HAND or OFF. For manually operated motors with H-O-S switches, motors selected for STANDBY shall operate if a motor selected for HAND fails to operate.

PART II: DETAILED SYSTEM DESCRIPTION

2.1 GROUNDWATER COLLECTION WELL

- A. General. A groundwater collection well is used to collect ground water from a portion of the 881 Hillside area. The collected water is pumped to the influent storage tanks. This well and ancillary equipment will be constructed as part of Phase IIB. The following information is for reference only. The well pump shall be controlled by the PLC based on input signals received from remote monitoring and control devices in the well and the storage tanks. From the signal inputs, the PLC shall generate and transmit signals as required to start and stop P-100. General ICM requirements for the collection well shall include the following:
1. Indicate P-100 status locally at FP-100 (OL-100A) and at the MCP (OL-100B).
 2. Alarm P-100 failure locally at FP-100 (OA-100A) and at the MCP (OA-100B).
- B. Manual Control Mode. This mode of control allows a plant operator to start and stop P-100 as follows.
1. P-100 shall be controlled at the MCP by a HAND/OFF/AUTO hand switch (HS-100B). When HS-100B is in the Auto position, P-100 shall be controlled by the PLC. When HS-100B is in the OFF position, P-100 shall be off. When HS-100B is in HAND, P-100 shall run.
 2. The JOG/OFF/AUTO switch (HS-100A) on FP-100 shall still be able to activate P-100 when HS-100B is in the OFF position. When HS-100A is in the OFF position, it shall override control by the PLC regardless of the position of HS-100B.
- C. Normal Automatic Control. P-100 shall be automatically controlled by the PLC when HS-100B is in the AUTO position. The requirements for this control are as follows.
1. Well level shall be measured (LE-100, LIT-100), and P-100 started on high level (LSH-100) and stopped on low level (LSL-100).
 2. The destination tank for P-100 is selected manually by the operator by opening D-201 or D-202 inlet valves HV-201A or HV-202A, respectively. P-100 shall be prevented from starting unless there is a proper pumping path and the tank selected for filling is not full [Section 2.4(B)(1)(d) and 2.4(B)(3)(a)].

3. P-100 shall be stopped upon a complete system shutdown initiated by the PLC.

2.2 COLLECTION SUMPS

- A. General. The collection sumps are used to collect ground water at low points in the french drain system. The collected water is pumped to the influent storage tanks, by pumps P-101, P-102, P-103 and P-104. These pumps shall be controlled by the PLC based on input signals received from remote monitoring and control devices in the sumps and the storage tanks. From the signal inputs, the PLC shall generate and transmit signals as required to start and stop the pumps. General ICM requirements for the collection sumps shall include the following.
 1. Measure the flowrate (FE-101), indicate and totalize flow locally (FQI-101A), transmit (FIT-101) and totalize flow at the MCP (FQI-101B).
 2. Indicate the respective pump status locally at FP-101 and FP-102. (OL-101A, OL-102A, OL-103A and OL-104A) and at the MCP (OL-101B, OL-102B, OL-103B, and OL-104B).
 3. Alarm pump(s) failure locally at FP-101 and FP-102 (OA-101A, OA-102A, OA-103A and OA-104A) for the respective pump and at the MCP (OA-101B, OA-102B, OA-103B and OA-104B).
- B. Manual Control Mode. This mode of control allows a plant operator to start and stop the collection sump pumps as follows.
 1. The pumps shall be controlled at the MCP by HAND/OFF/AUTO switches (HS-101B, HS-102B, HS-103B and HS-104B). When HS-10XB is in the HAND position, P-10X shall operate independent of any output from the PLC. When HS-10XB is in the OFF position, P-10X shall be off.
 2. The JOG/OFF/AUTO switch (HS-101A, HS-102A, HS-103A and HS-104A) on FP-101 and FP-102 shall still be able to activate the pumps when HS-10XB is in the OFF position. When HS-10XA is in the OFF position, it shall override control by the PLC regardless of the position of HS-10XB.
- C. Normal Automatic Control. The collection sump pumps shall be automatically controlled by the PLC when HS-10XB is in the AUTO position. The requirements for this control are as follows.
 1. Sump level shall be measured (LE-101, LIT-101, LE-103, LIT-103), and the lead pump, P-101, P-103, started on high level (LSH-101, LSH-103) and stopped on low level (LSL-101, LSL-103). The lag pump, P-102, P-104, shall be

started on increasing level, and both pumps stopped on low level.

2. An alternator circuit shall be provided in the PLC to switch the lead and lag pump after each use and on pump failure.
3. The destination tank for the collection sump pumps is selected manually by the operator by opening D-201 or D-202 inlet valves, HV-201A or HV-202A, respectively. The pumps shall be prevented from starting unless there is a proper pumping path and the tank selected for filling is not full [Section 2.4(B)(1)(d) and 2.4(B)(3)(a)].
4. The collection sump pumps shall be stopped upon a complete system shutdown initiated by the PLC.

2.3 BUILDING 891 SUMP PUMPS

- A. General. This sump is used to collect any water discharged to the floor in Building 891. The collected water is pumped to the influent storage tanks, D-201 or D-202, by pumps P-107 and P-108. These pumps shall be ABS Model SEVH-4W, or approved equal, as described in Section 15140. These pumps shall be controlled locally based on sump level. Signals to prevent the pumps from starting can also be generated and transmitted by the PLC. General ICM requirements for the sump shall include the following.
 1. Indicate pump(s) status locally at FP-107 (OL-107A, OL-108A) and at the MCP (OL-107B, OL-108B).
 2. Alarm pump(s) failure locally at FP-107 (OA-107A, OA-108A) and at the MCP (OA-107B, OA-108B).
- B. Manual Control Mode. This mode of control allows a plant operator to start and stop P-107A and P-108B as follows.
 1. The pumps shall be controlled locally at FP-107 by HAND/OFF/AUTO switches (HS-107, HS-108). When HS-107 or HS-108 are in the HAND position, P-107 or P-108 shall operate independent of any output from local controls or the PLC. When HS-107 or HS-108 are in the OFF position, P-107 or P-108 shall be off.
- C. Normal Automatic Control. The Building 891 sump pumps shall be automatically controlled by the PLC when HS-107 or HS-108 are in the AUTO position. The requirements for this control are as follows.
 1. Sump level shall be measured (LE-107) and the lead pump started on high level (LSH-107), and the lag pump started

on high-high level (LSHH-107). Both pumps shall be stopped on low level (LSL-107).

2. An alternator circuit shall be provided by the PLC to switch the lead and lag pump after each use and on pump failure.
3. The destination tank for P-107 and P-108 is selected manually by the operator by opening D-201 or D-202 inlet valves HV-201A or HV-202A, respectively. P-107 and P-108 shall be prevented from starting unless there is a proper pumping path and the tank selected from filling is not full [(Section 2.4(B)(1)(d) and 2.4(B)(3)(a))].
4. An alarm and automatic telephone dialer (Section 17550) shall be activated on high-high sump level (LSHH-107).

2.4 INFLUENT STORAGE TANKS

- A. General. Influent storage tanks D-201 and D-202 are 15,000 gallon tanks used to store collected ground water prior to treatment through the UV/peroxide and ion exchange treatment units. These tanks will be provided by the Buyer as GFE. Generally, one tank will be the destination tank for water pumped by pumps P-100 through P-108, while the other tank will be the source tank for water pumped to the treatment units by pumps P-301 and P-302. The selection of destination and source tanks is made manually by the operator by opening and/or closing the tank inlet and outlet valves. The PLC will enable and disable various systems, as well as monitor and control tank level and temperature, based on input signals received from remote monitoring and control devices located in the tanks and attached piping.
- B. Normal Automatic Control. D-201 and D-202 are normally under automatic control by the PLC. The requirements for this control are as follows.
 1. Measure tank level (LE-201, LE-202) and indicate locally (LIT-201, LIT-202). Transmit a signal to the PLC and provide the following signals and/or indicators.
 - a. Indicate level at the MCP (LI-201, LI-202).
 - b. On tank high-high level (LSHH-201, LSHH-202), activate an alarm at the MCP (LAHH-201, LAHH-202) and the automatic telephone dialer (Section 17550).
 - c. On low-low level (LSLL-201, LSLL-202), prevent the heating elements in the tanks from operating.
 - d. On high level (LSH-201, LSH-202), prevent pumps P-100 through P108 from operating when the corresponding

tank inlet valve (HV-201A, HV-202A) is open. Also, regardless of valve position, activate an alarm at the MCP (LAH-201, LAH-202).

- e. On low level (LSL-201, LSL-202), prevent pumps P-301 and P-302 and the UV/peroxide treatment unit from operating when the corresponding tank outlet valve (HV-201B, HV-202B) is open. Also, regardless of valve position, activate an alarm at the MCP (LAL-201, LAL-202).
2. Measure tank temperature and indicate locally (TI-201A, TI-202A). Transmit a signal (TT-201, TT-202) to the PLC and provide the following signals and/or indicators.
- a. Indicate temperature at the MCP (TI-201B, TI-202B).
 - b. On tank high-high or low-low temperature (TSHH-201, TSHH-202, TSLL-201, TSLL-202), activate an alarm at the MCP (TAHH-201, TAHH-202, TALL-201, TALL-202) and the automatic telephone dialer (Section 17550).
 - c. On low temperature (TSL-201, TSL-202), start tank heating element operation.
 - d. On high temperature (TSH-201, TSH-202), stop tank heating element operation.
3. Monitor tank inlet and outlet valve position (ZSH-20XA/B, ZSL-20XA/B) and indicate at the MCP (ZLH-20XA/B, ZLL-20XA/B). Transmit a signal to the PLC and provide the following signals and/or indicators.
- a. Prevent pumps P-100 through P-108 from operating if both of the tank inlet valves (HV-201A, HV-202A) are closed, or if the tank inlet valve is open on a tank which is at high level (LSH-201, LSH-202).
 - b. Prevent pumps P-301 and P-302, and the UV/peroxide treatment unit, from operating if the tank outlet valve (HV-201B, HV-202B) is open on a tank which is at low level (LSL-201, LSL-202).

2.5 EFFLUENT STORAGE TANKS

- A. General. Effluent storage tanks D-205, D-206 and D-207 are 159,000 gallon tanks used to store treated ground water prior to discharge. These tanks will be provided by the Buyer as GFE. Generally, one tank will be filling with treated ground water as a second tank is being sampled, analyzed, and discharged. The third tank is kept in reserve in the event that sample analysis is delayed, or if an off-specification tank is discovered. The selection of the intended use of the

tank is made manually by the operator by opening and/or closing the tank inlet, outlet and recycle valves. The PLC will then enable and disable various systems, as well as monitor and control tank level and temperature, based on input signals received from remote monitoring and control devices located in the tanks and attached piping.

B. Normal Automatic Control. D-205, D-206 and D-207 are always under automatic control by the PLC. The requirements for this control are as follows.

1. Measure tank level (LE-205, LE-206, LE-207) and indicate locally (LIT-205, LIT-206, LIT-207). Transmit a signal to the PLC and provide the following signals and/or indicators.
 - a. Indicate level at the MCP (LI-205, LI-206, LI-207).
 - b. On tank high-high level (LSHH-205, LSHH-206, LSHH-207), activate an alarm at the MCP (LAHH-205, LAHH-206, LAHH-207) and the automatic telephone dialer (Section 17550).
 - c. On high level (LSH-205, LSH-206, LSH-207), prevent the ion exchange treatment unit from operating when the corresponding tank inlet valve (HV-205A, HV-206A, HV-207A) is open.
 - d. On low level (LSL-205, LSL-206, LSL-207) activate an alarm at the MCP (LAL-205, LAL-206, LAL-207). In addition, provide for the following.
 - . If the tank is being recycled for processing through the UV/peroxide treatment unit via pumps P-301 or P-302 (HV-501 and HV-205C, HV-206C, or HV-207C open), prevent the pumps and the treatment unit from operating.
 - . If the tank is being recycled for processing through the ion exchange treatment unit (HV-502, and HV-205C, HV-206C, or HV-207C open), prevent the ion exchange treatment unit from operating.
2. Measure containment wall level (LE-205, LE-206, LE-207) and indicate locally (LIT-215, LIT-216, LIT-217). Transmit a signal to the PLC and provide the following signals:
 - a. On high-high level (LSHH-215, LSHH-216, LSHH-217) activate an alarm at the MCP (LAHH-215, LSHH-216, LSHH-217), and the automatic telephone dialer (Section 17550).

3. Monitor tank inlet, outlet, and recycle valve position (ZSH-205A/B/C, ZSH-206A/B/C, ZSH-207A/B/C, ZSH-500, ZSH-501, ZSH-502, ZSL-205A/B/C, ZSL-206A/B/C, ZSL-207A/B/C, ZSL-500, ZSL-501, ZSL-502) and indicate at the MCP (ZLH-205A/B/C, ZLH-206A/B/C, ZLH-207A/B/C, ZLH-500, ZLH-501, ZLH-502, ZLL-205A/B/C, ZLL-206A/B/C, ZLL-207A/B/C, ZLL-500, ZLL-501, ZLL-502). Transmit a signal to the PLC and provide the following signals and/or indicators.
 - a. Prevent the ion exchange treatment unit from operating under the following conditions.
 - All tank inlet valves (HV-205A, HV-206A, HV-207A) and effluent recycle valve (HV-500) closed, or if the tank inlet valve is open on a tank which is at high level (LSH-205, LSH-206, LSH-207).
 - Tank inlet valve (HV-205A, HV-206A, HV-207A) and outlet valve (HV-205B, HV-206B, HV-207B) are open on the same tank.
 - Ion exchange recycle valve (HV-502) is open, but none of the tank recycle valves (HV-205C, HV-206C, HV-207C) or the effluent recycle valve (HV-500) are open.
 - Tank is being recycled for processing (HV-502 and HV-205C, HV-206C, or HV-207C open), and the tank is at low level (LSL-205, LSL-206, LSL-207).
 - b. Prevent pumps P-301 and P-302, and the UV/peroxide treatment unit from operating under the following conditions.
 - UV/peroxide recycle valve (HV-501) is open, but none of the tank recycle valves (HV-205C, HV-206C, HV-207C) or the effluent recycle valve (HV-500) are open.
 - Tank is being recycled for processing (HV-501 and HV-205C, HV-206C, or HV-207C open), and the tank is at low level (LSL-205, LSL-206, LSL-207).

2.6 ION EXCHANGE SURGE TANK

- A. General. The ion exchange surge tank, D-203, is a 15,000 gallon tank used to provide temporary storage between the UV/peroxide and ion exchange treatment units. It also allows time for the decay of residual peroxide and the release of heat added by the UV/peroxide system. The PLC will enable and

disable various systems, as well as monitor and control tank level and temperature, based on input signals received from remote monitoring and control devices located in the tank and attached piping.

B. Normal Automatic Control. D-203 is always under automatic control by the PLC. The requirements for this control are as follows.

1. Measure tank level (LE-203) and indicate locally (LIT-203). Transmit a signal to the PLC and provide the following signals and/or indicators.
 - a. Indicate level at the MCP (LI-203).
 - b. On tank high-high level (LSHH-203), activate an alarm at the MCP (LAHH-203) and the automatic telephone dialer (Section 17550).
 - c. On low-low level (LSLL-203), prevent the heating elements in the tank from operating.
 - d. On high level (LSH-203), prevent pumps P-301 and P-302, and the UV/peroxide treatment unit from operating. Also, regardless of valve position, activate an alarm at the MCP (LAH-203).
 - e. On low level (LSL-203), prevent the ion exchange treatment unit from operating.
2. Measure tank temperature and indicate locally (TI-203A) and at the MCP (TI-203B). Transmit a signal (TT-203) to the PLC and provide the following signals and or indicators.
 - a. Indicate temperature at the MCP (TI-203B).
 - b. On tank high-high or low-low temperature (TSHH-203, TSLL-203), activate an alarm at the MCP (TAHH-203, TALL-203) and the automatic telephone dialer (Section 17550).
 - c. On low temperature (TSL-203), start tank heating element operation.
 - d. On high temperature (TSH-203), stop tank heating element operation.
3. Monitor tank inlet and outlet valve position (ZSH-203A/B, ZSL-203A/B) and indicate at the MCP (ZLH-203A/B, ZLL-203A/B). Transmit a signal to the PLC and provide the following signals and/or indicators.

- a. Prevent pumps P-301 and P-302 and the UV/peroxide treatment unit from operating if the tank inlet valve (HV-203A) is closed, or if the tank inlet valve is open when the tank is at high level (LSH-203).
- b. Prevent the ion exchange treatment unit from operating if the tank outlet valve (HV-203B) is open and the tank is at low level (LSL-203).

2.7 UV/PEROXIDE FEED PUMPS

- A. General. Pumps P-301 and P-302 are used to pump collected water from D-201 or D-202, or off-specification water from D-205, D-206 or D-207, through the UV/peroxide treatment unit to D-203. These pumps shall be Aurora model 321, or approved equal, as described in Section 15140. These pumps shall be controlled by the PLC based on input signals received from remote monitoring and control devices in the tanks and attached piping, or from the treatment units. From the signal inputs, the PLC shall generate and transmit signals as required to start and stop the pumps.
- B. Normal Automatic Control
 1. P-301 and P-302 are manually selected at the MCP by the operator (HS-301B, HS-302B), but are always under automatic control by the PLC. The requirements for this control are as follows.
 - a. When HS-301B is in the auto position, HS-302B shall be in the OFF position, and P-301 shall be controlled by the PLC.
 - b. When HS-302B is in the auto position, HS-301B shall be in the OFF position, and P-302 shall be controlled by the PLC.
 - c. The JOG/OFF/AUTO switches (HS-301A, HS-302A) shall override control by the PLC regardless of the position of switches HS-301B and HS-302B.
 2. Pump status shall be indicated at the MCP (OL-301, OL-302).
 3. P-301 or P-302 shall be prevented from starting, or will be stopped if already operating, upon the following conditions.
 - a. Low level in D-201 or D-202 when the corresponding tank outlet valve (HV-201B, HV-202B) is open. [Section 2.4 (B) (1) (e) and 2.4 (B)(3)(b)].

- b. Low level in D-205, D-206, or D-207 when the corresponding tank recycle valve (HV-205C, HV-206C, HV-207C) and UV/peroxide recycle valve (HV-501) are open. [Section 2.5(B)(1)(d) and 2.5 (B)(3)(b)].
- c. High level in D-203 when the tank inlet valve (HV-203A) is open [Section 2.6 (B)(1)(d) and 2.6 (B)(3)(a)].
- d. UV/peroxide recycle valve (HV-501) open, but none of the tank recycle valves (HV-205C, HV-206C, HV-207C) or the effluent recycle valve (HV-500) are open [Section 2.5 (B)(2)(b)].
- e. D-203 inlet valve (HV-203A) closed [Section 2.6 (B)(3)(a)].
- f. D-201 and D-202 outlet valves (HV-201B, HV-202B) and UV/peroxide recycle valve (HV-501) all closed.
- g. Shutdown of UV/peroxide treatment unit initiated by the treatment unit ICM system.

2.8 CHEMICAL STORAGE AND FEED SYSTEMS - NEUTRALIZATION

- A. General. The chemical storage and feed system is used to store concentrated hydrochloric acid (HCl) and sodium hydroxide (NaOH) solutions for use in ion exchange column regeneration and spent regenerant neutralization. The HCl and NaOH tanks are 2,500 and 1,250 gallons, respectively. Unloading pumps P-208 and P-209 are used to load the tanks with solutions delivered in bulk. Metering pumps supplied with the ion exchange treatment unit (provided as GFE by the Buyer) are used for the actual regeneration and neutralization operations. The chemical storage and feed system shall be controlled locally and shall not require any signals from the PLC. ICM requirements for the system are as follows.
- B. Normal Local Controls. Local controls shall be provided at FP-208 and FP-209 for the unloading pumps and for level. Requirements for this control are as follows.
 - 1. Unloading pumps P-208 and P-209 shall be controlled locally at FP-208 and FP-209 by ON/OFF hand switches (HS-208A, HS-209A).
 - 2. Pump status shall be indicated locally at FP-208 and FP-209 (OL-208A, OL-209A) and at the MCP (OL-208B, OL-209B).
 - 3. Alarm pump(s) failure locally at FP-208 and FP-209 (OA-208A, OA-209A) and at the MCP (OA-208B, OA-209B).

4. Measure tank level and transmit (LE-208, LE-209, LIT-208, LIT-209) and indicate at the MCP (LI-208, LI-209). Based on level, provide the following signals and/or indicators.
 - a. On low level (LSL-208, LSL-209), activate an alarm locally at FP-208 or FP-209 (LAL-207, LAL-208).
 - b. On high level (LSH-208, LSH-209), activate an alarm locally at the MCP and outside the building (LAH-208, LAH-209).

2.9 CLEAN WATER STORAGE SYSTEM

- A. General. Clean water storage tank D-204 is a 15,000 gallon tank used to store treated water for use in ion exchange system backwashing, rinsing, and chemical dilution. The tank is filled by opening transfer valve V-204. A clean water transfer pump is used to supply water to the ion exchange treatment unit (both provided as GFE by the Buyer). The PLC will enable and disable various systems, as well as monitor and control tank level and temperature, based on input signals received from remote monitoring and control devices located in the tank.
- B. Normal Automatic Control. D-204 is always under automatic control by the PLC. The requirements for this control are as follows.
 1. Provide hand switch (HS-204) at the MCP to open and close transfer valve V-204.
 2. Measure tank level (LE-204) and indicate locally (LIT-204). Transmit a signal to the PLC and provide the following signals and/or indicators.
 - a. Indicate level at the MCP (LI-204).
 - b. On high-high level (LSHH-204), close valve V-204, activate an alarm at the MCP (LAHH-204) and transmit a signal to prevent the ion exchange treatment unit from operating.
 - c. On low-low level (LSLL-204), prevent the heating elements in the tank from operating.
 - d. On high level (LSH-204), close valve V-204. In addition, activate an alarm at the MCP (LAH-204).
 - e. On low level (LSL-204), transmit a signal to the ion exchange treatment unit to stop the clean water transfer pump. In addition, activate an alarm at the MCP (LAL-204).

SECTION 17100

PRIMARY ELEMENTS

PART I: GENERAL

1.1 DESCRIPTION: This Section specifies primary elements of process instrumentation, auxiliary equipment and supplies directly related to the installation of and operation of these primary elements, to perform the required functions in conjunction with information and equipment specified in other ICM Sections. Schedules indicating required information are attached at the end of this Section, but shall not be construed as Bills of Material or as a complete listing of all required devices.

1.2 QUALITY ASSURANCE

- A. Manufacturer. In addition to the requirements of Section 17000, instrumentation and controls equipment furnished shall be manufactured by a firm regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.
- B. Maintainability. All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.
- C. Materials and Installations. Materials and installations shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

PART II: PRODUCTS

2.1 LEVEL SENSORS

- A. Radio Frequency Type Level Sensors. Unit shall employ an admittance measurement technique using low power RF to measure the level of a product in a grounded vessel. The sensing element shall be the immersion type with mounting suitable for installation shown. Sensing element shall be Teflon coated and shall be constructed so as to be unaffected by coating build-up. The sensing element shall be interconnected to an

indicating transmitter by an integral cable with length as shown (100 ft max). Sensor and interconnecting cable shall be intrinsically safe in accordance with NFPA 493.

Indicating transmitter shall be suitable for pipestand or wall mounting with a NEMA 4X enclosure. The indicating transmitter shall output a 4-20mA signal, linearly proportional to the level, into a 400 ohm load impedance without load adjustments. Output span and zero shall be field adjustable 0-30 seconds measured. RFI filters shall be provided, as required, to eliminate extraneous interference effects. Indicator shall be 3 inch scale minimum, visible from outside the unit and shall be linearly graduated with scale range as noted. Overall system accuracy shall be ± 1.0 percent of full scale for sensing element temperatures to 200 degrees F and 150 psig pressure.

- B. Manufacturer. The unit shall be a Drexelbrook type 508, Level Measuring System. For fiberglass tank service, the unit shall include a ground reference electrode. No substitutions are permitted.

2.2 PRESSURE AND VACUUM GAGES

- A. Pressure and Vacuum Gages. Pressure and vacuum gages shall, unless otherwise specified, conform with the following. Gages shall be of the stem mounting type unless panel mounted type is shown on the Schedule.
- B. Construction. Gages shall be liquid filled and be of the bourdon tube or bellows type with 270 degrees C. W. pointer travel. Dials shall be white with black numerals. Accuracy shall be 1% and dial size shall be 4-1/2 inches unless otherwise shown on the Gage Schedule. Panel mounted gages shall have round bezels for flush mounting and rear connection, others shall have a stem mounting bottom connection. Connections for all gages shall be male 1/2 NPT with square wrench flats. Wetted parts shall be 316 stainless steel and shall be the manufacturer's best quality standard. Cases shall be black phenolic or 316 stainless steel.
- C. Manufacturer. The gages shall be a product of Ashcroft, U.S. Gage, or equal.

2.3 LIMIT SWITCHES

Limit switches shall be provided to sense limiting positions of equipment, such as valves, as shown on the drawings and/or specified in the Schedules. The limit switches shall be SPDT or DPDT as required for the specified operations or as scheduled herein. The switches shall be rated for 5 amperes minimum at 120 Vac and shall be enclosed in a NEMA 4 housing unless explosion proof (XP) is specified in the schedule. Provision shall be made for 1/2" electrical conduit connection. The switches shall incorporate

actuators and mounting brackets which are fabricated appropriately for the mechanical equipment being monitored. Switches shall be as manufactured by Microswitch, Namco, or equal.

2.4 THERMOMETERS

Bi-metal type dial thermometers shall be provided where indicated on the plans and as specified herein. Thermometers shall be 5-inch diameter with adjustable angle dial. Thermometers shall be installed in type 316 stainless steel thermowells. The insertion length shall be not less than 1/3 of pipe diameter. Well shall have extension necks on all insulated pipes where necessary. Thermowells shall be of the solid bored type. Thermometers shall have ranges as indicated in the Thermometer Schedule. Thermometers and wells shall be installed in the piping through welded thread-o-lets or flange adapters as indicated generally on the plans, but they shall be field located for best readability. Location of thermometers is subject to engineer's approval.

- A. Manufacturer. Thermometers shall be as manufactured by the H. O. Trerice Company, Weston, Dresser or by Manning, Maxwell and Moore, Inc., or equal.

2.5 TEMPERATURE SENSORS

- A. General. Temperature sensors shall be 100 ohm (RTD) platinum resistance element. Type (RTD) sensors shall have a temperature resistance relationship and tolerances for 100 ohm platinum resistance element per SAMA Standard RC21-4-1966 corrected for IPTS 68.
- B. Construction. Temperature sensors shall be equipped with accessory equipment as indicated on the drawings, and specified on the Schedule. In general, accessory equipment shall consist of general purpose, NEMA and/or explosion proof connection heads; pipe extension with union connectors or bushings; wells or protecting tubes and spring-loading assemblies. Sensors of standard construction will be specified on the Schedule; specially constructed sensors will be specified on the Schedule with details shown on the drawings.

Well or protecting tube material shall be as specified on the Schedule. Sensors shall be integrally mounted with transmitters. Transmitters shall be as specified elsewhere in this Section.

- C. Quality. Type (RTD) sensors shall be as manufactured by Rosemount or approved equal.

2.6 TEMPERATURE TRANSMITTERS - ELECTRIC

- A. General. Electric temperature transmitters shall be integrally mounted with temperature sensors. The range shall be as

specified on the Schedule. Transmitters shall convert the temperature measurement to a 4 to 20 mA dc signal capable of transmission into at least a 500 ohm load at 24 V or less. Signal and power transmission shall be provided by a single pair of wires. Operating ambient temperature shall be at least -40 to +82°C. Reference accuracy shall be ± 0.2 percent of span or better. A process variable indicating meter shall be provided.

- B. Construction. Transmitter enclosures shall be NEMA 4 rated except where explosion proof (XP) is specified on the Schedule. The sensor shall be mounted to the transmitter enclosure by threaded coupling.
- C. Quality. Transmitters shall be Rosemount 444 or approved equal.

2.7 pH TRANSMITTERS

- A. General. The pH sensor shall consist of a general purpose electrode and a double junction gel filled reference electrode. An hermetically sealed preamplifier shall be a part of the sensor unit.

The sensor shall connect to a two wire transmitter via a ten foot cable.

The transmitter shall measure a range of 2 - 14 pH, and will output a 4 - 20 mA signal corresponding to that range. The transmitter shall be capable of driving a 700 ohm load at 24 volts. Local indication shall be provided.

- B. Quality. The transmitter shall be a Rosemount Model 1181 or approved equal. The sensor shall be a Rosemount model 399 or approved equal.

2.8 SCHEDULES (SEE ATTACHED)

PART III EXECUTION

Installation, testing and start-up shall be in accordance with Section 17000 of these specifications.

END OF SECTION 17100

RADIO FREQUENCY TYPE LEVEL SENSOR SCHEDULE

Tag No.	Level Range (feet)	Process Medium	Temp. Range (°F)	Max. Press. (psig)	Output Analog (4-20 ma) if other so state	Output Switches SPDT	Indicator Units	P & ID
LE-107	0-2.5	Water	30-80	5	Yes	None	Feet	38548-006
LE-201	0-9	Water	30-80	5	Yes	None	Feet	38548-007
LE-202	0-9	Water	30-80	5	Yes	None	Feet	38548-007
LE-203	0-9	Water	30-150	5	Yes	None	Feet	38548-008
LE-204	0-9	Water	30-80	5	Yes	None	Feet	38548-009
LE-205	0-5	Water	30-80	5	Yes	None	Feet	38548-010
LE-206	0-5	Water	30-80	5	Yes	None	Feet	38548-010
LE-207	0-5	Water	30-80	5	Yes	None	Feet	38548-010
LE-208	0-5	20° Be Hydrochloric Acid	30-80	5	Yes	None	Feet	38548-009
LE-209	0-5	Water, pH 2-14	30-80	5	Yes	None	Feet	38548-009
LE-210	0-13	50% Wt. Sodium Hydroxide	30-80	5	Yes	None	Feet	38548-009
LE-215	0-2	Water	30-80	0	Yes	None	Feet	38548-010
LE-216	0-2	Water	30-80	0	Yes	None	Feet	38548-010
LE-217	0-2	Water	30-80	0	Yes	None	Feet	38548-010

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PRESSURE-VACUUM GAGE SCHEDULE

Tag No.	Press Range (psig)	Process Fluid	Wetted Parts	Isolator Req'd	Dampener Req'd	Panel Mount	P & ID
PI-301	0-15	Water	316SS	None	None	No	38548-007
PI-302	0-15	Water	316SS	None	None	No	38548-007
PI-210	0-15	Water	316SS	None	None	No	38548-009

THERMOMETER SCHEDULE

Tag No.	Temp Range (°F)	Thermowell	Process Press (psig)	Indicator scale (°F)	Accuracy	P & ID
TI-201A	0-100	3/4" NPT x 8" 316 SS	5	0-100	1%	38548-007
TI-202A	0-100	3/4" NPT x 8" 316 SS	5	0-100	1%	38548-007
TI-203A	0-150	3/4" NPT x 8" 316 SS	5	0-200	1%	38548-008
TI-204A	0-100	3/4" NPT x 8" 316 SS	5	0-100	1%	38548-009

TEMPERATURE SENSOR SCHEDULE

Tag No.	Type	Well Material	Integral Transmitter (yes/no)	Temp Range (°F)	Accessories
TE-201	RTD	3/4" NPT x 8" 316 SS	Yes	0-100	Local Indicator
TE-202	RTD	3/4" NPT x 8" 316 SS	Yes	0-100	Local Indicator
TE-203	RTD	3/4" NPT x 8" 316 SS	Yes	0-150	Local Indicator
TE-204	RTD	3/4" NPT x 8" 316 SS	Yes	0-100	Local Indicator

TEMPERATURE TRANSMITTER-ELECTRIC SCHEDULE

Tag No.	Range (°F)	Indicator Scale	Explosion Proof (XP)	P&ID
TT-201	0-100	0-100	Yes	38548-007
TT-202	0-100	0-100	Yes	38548-007
TT-203	0-150	0-150	Yes	38548-007
TT-204	0-100	0-100	Yes	38548-007

pH TRANSMITTER SCHEDULE

Tag No.	pH Range	pH Indicator Scale	Explosion Proof (XP)	P&ID
AE/AT-210	2-14	2-14	Yes	38548-009

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SECTION 17200

PANEL MOUNTED AND MISCELLANEOUS FIELD INSTRUMENTS

PART I: GENERAL

1.1 DESCRIPTION: This Section specifies the panel mounted and miscellaneous field instruments and equipment to perform the required functions in conjunction with information and equipment specified in other ICM Sections. Schedules where required for equipment appear at the end of this Section. These shall not be construed as complete bills of material.

A. Unit Responsibility. It shall be the responsibility of ICM Subcontractor as described in Section 17000 to insure that the instruments and equipment furnished under this Section are compatible with the equipment furnished under the ICM Sections and other Divisions of these Specifications, and that the signal transmission methods are compatible.

B. Cases of front of panel mounted instruments shall be of uniform design and color scheme wherever possible. Front of case colors shall be compatible with panel colors and subject to final approval by the Buyer. Normally, compatible standard colors of the manufacturer shall be acceptable.

C. Programmable Multi-Function Units. Although the controllers, signal conditioners, converters, etc. are specified herein as separate single purpose units, wherever it is feasible the programmable logic controllers shall be used to accomplish the same functions.

1.2 QUALITY ASSURANCE

A. Manufacturer. In addition to requirements of Section 17000, instrumentation and control equipment furnished shall be manufactured by a firm regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the most recent design. Except where stated otherwise, the instruments furnished under this Section shall be as manufactured by Fischer & Porter, Honeywell, Foxboro, Taylor, or approved equal. Unless otherwise stated ancillary equipment shall be as manufactured by the above or Rochester Instruments, AGM Electronics, Moore Industries, or approved equal.

B. Maintainability. All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field

adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

- C. Materials and Installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

PART II: PRODUCTS

2.1 PROCESS VARIABLE INDICATORS

- A. Process Variable Indicators shall have a vertical display and the scale shall be at least 3 inches long, shall have a reference accuracy of plus or minus 2.0 percent or better, and the indicator shall be driven by the output of a solid state electronic amplifier. Zero and span adjustment shall be provided. Indicating scale graduations shall be as indicated in the Process Variable Indicator Schedule. Also when specified in the Schedule indicators shall have a solid state "bar graph" display.

Indicators shall be the electronic type with independent dual bar graphs and digital readout at the top. Scales shall be linearly graduated in engineering units. Indicators shall each have a separate DC power supply. The case size shall be 3 in. by 6 in. suitable for panel mounting. Indicators shall be Dixon DIN.

- B. Large Case Process Indicators shall be provided as shown on the plans and/or specified herein. Scale units shall be as specified in the Schedule. The pointer shall be servo driven with feedback and null balancing. Accuracy shall be .5% of full scale. Input signal shall be 4-20 mA_{dc} unless otherwise specified in the Schedule. An optional integrator and 7 digit totalizer shall be provided when required in the Schedule. When specified, SPDT alarm switches shall be provided, rated at 2 amperes, 120 Vac, 60 Hz. Indicators shall have 4-3/8 inch minimum scale length, and hinged locking door with glass window. Dimensions shall be 15" x 14" x 8" deep maximum.
- C. Digital Indicators shall be provided where indicated and shall display the decimal value of an analog voltage or current input or other digitally coded input as specified in the Schedule. The number and size of the digits shall be as specified. The displayed digits shall be liquid crystal

display (LCD) and easily visible in a well lighted control room. The display style shall be the choice of the ICM subcontractor, except that all displays shall be of the same style. The accuracy of the display shall be within one digit but not less than +0.1% for analog inputs. There shall be no error with digital inputs. Automatic ranging and polarity selection and sign indication shall be provided when specified in the Schedule.

2.2 RECORDERS

- A. Strip Chart. One, two, and three pen strip chart recorders shall be installed where indicated. Charts shall be 4 inches and scales shall be oriented vertically. On a given recorder, each pen shall use a different color of ink. The recorder pens shall be individually servo-motordriven. Electrical zero and span adjustment shall be provided. Chart graduations shall be rectilinear. If shown on the Schedule, two chart speeds shall be available by switch or lever selection. The lower speed shall be 3/4 inch per hour minimum and eight hours of record shall be visible without manually moving the chart; the higher speed shall be 60 times faster than the lower speed. An internal switch shall be provided for chart drive on/off. The charts and scales shall be graduated as shown in the strip chart Recorder Schedule. When specified in the Schedule, high and low limit switches shall be provided. Reference accuracy for all recorders shall be plus or minus 0.5 percent of span. Charts shall record 31 days at slow speed. Where indicated in the Schedule and on the Drawings, trend panels shall be provided with the recorders.
- B. Circular Chart. Circular chart recorders shall be provided as shown on the plans and/or specified herein. Charts shall be motor driven for one revolution per 24 hours or per 7 days as specified in the Schedule. Where two or more pens are specified in the Schedule each shall use a different color ink. Each pen shall be servo driven with feed back and null balancing. Accuracy shall be 0.5% of full scale. Input signal shall be 4-20 mA_{dc} unless otherwise specified in the Schedule. An optional integrator and 7 digit totalizer shall be provided when required in the Schedule. When specified, SPDT alarm switches shall be provided, rated at 2 amperes, 120 Vac, 60 Hz. Recorders shall have 12 inch charts, manual pen lifter, and weather proof case with hinged locking door with glass window. Dimensions shall be 10" x 15" x 12" deep maximum. Operating power shall be 120 Vac, 60 Hz. A drive on/off switch shall be provided.

2.3 SIGNAL CONDITIONERS AND CONVERTERS

- A. General. Signal conditioners and converters shall be provided as shown on the Drawings and/or as specified

herein. They shall have all solid state circuits on plug-in printed circuit boards and housed in card cages or single cases for in-panel mounting and weather proof or explosion proof cases for field mounting depending on the area rating. Accuracy shall be ± 0.25 percent unless shown otherwise. They shall be as manufactured by Moore Industries, Moore Products, AGM Electronics, Moore Industries, Rochester Instruments, or equal.

- B. Signal Selectors. Signal selectors shall receive up to four DC control signals and shall retransmit the lower, the intermediate, or the higher of the signals, as specified in the Schedule.
- C. Signal Isolators and Impedance Convertors. Signal isolators and impedance converters shall be provided as required to insure system compatibility and shall be either field-mounted or back-of-panel mounted in the control panels. Current to current converters shall be provided when shown in the Schedule and shall provide DC isolation between two 4-20 mAdc signals. The output shall be capable of delivering 20 ma into 1,000 ohms.
- D. Signal Rate Limiters shall be provided where indicated or as required for system stability. Rate limiters shall accept a 4-20 mAdc input signal and output a 4-20 mA DC rate limited signal such that if the input varies at a rate in excess of pre-set rate the output will change linearly at the preset rate. When so specified in the Schedule there shall be a contact output to indicate that the output is being limited. The output signal increase and decrease rates shall be independently adjustable within the range specified in the Schedule.
- E. Signal Peak Limiter. The signal peak limiter shall accept a 4-20 mA signal and reproduce a 4-20 mA signal limited to a preset peak value. The peak value shall be adjustable over the upper 50 percent of the range as a minimum. The output until limited shall be identical to the input within the reference accuracy. The reference accuracy and repeatability of the limiting shall be 0.25 percent.
- F. Ramp Generators. Ramp generators shall be provided where indicated and shall produce a 4 to 20 mA (or other DC signal as required) which varies linearly with time. The generator shall be capable of producing "up ramp" and "down ramp" signals which vary from zero to 100% or vice versa in an adjustable period of time. The up or down ramp modes shall be selected by closure of external contacts. When the ramp reaches the minimum or maximum level it shall remain constant at the zero or 100% level. The maximum ramp interval shall be as specified in the Schedule. The output shall be linear within $\pm 2\%$.

- G. Square Root Extractors shall be provided where indicated, shall accept 4 to 20 mAdc inputs and output a 4-20 mA DC signal which is a square root function of the input. Zero and span adjustment shall be provided. Reference accuracy shall be plus or minus 0.5 percent of span from 5 to 100 percent of span with adjustable dropout feature.
- H. Signal Summators. The signal summators shall accept the specified number of 4 to 20 mAdc signals, A, B, C, etc. and produce a sum equal to $k_1A + k_2B + k_3C$, etc. where the k_i are adjustable constants equal to or less than one. The output shall be another 4 to 20 mAdc signal linear and proportional to the sum. Automatic zero biasing for unused inputs and output zero and span adjustment shall be provided. Adjustment may be internal.
- I. Pulse-to-Current Converters. Pulse-to-current converters shall be provided as required and shall be capable of receiving a frequency range as shown in the Schedule and transmitting a proportional 4 to 20 mAdc current output signal with a reference accuracy of plus or minus 0.5 percent of the maximum output, zero and span adjustment of 50 percent shall be provided.
- J. Current-to-Pneumatic Converters. Current-to-pneumatic converters shall be furnished, where indicated, to accept a 4 to 20 mAdc signal and provide a 3 to 15 psig pneumatic output or as indicated in the Schedule. The outputs shall be field reversible (i.e., 15 to 3 psig) with zero and span adjustments. Housing shall be for pipe or surface mounting and weather proof or as required by the area in which they are located. An airset with gage shall be provided with each converter.
- K. Pneumatic-to-Current Converters. Pneumatic-to-current converters shall be furnished, where indicated to accept a 3 to 15 psig pneumatic signal and convert it to a 4 to 20 mAdc signal output. The output shall be reversible (i.e. 20-4 mA) with zero and span adjustments. An output indicator shall be provided with 0-100 percent scale.
- L. Potentiometer-to-Current Converters. Potentiometer-to-current converters shall be provided where indicated and shall convert a potentiometer setting to a linear 4 to 20 mAdc signal by detecting the relative resistance in each leg of a potentiometer. Total potentiometer resistance may be from 1,000 to 5,000 ohms as specified in the Schedule.
- M. Millivolt-to-Current Converters. Millivolt-to-current converters shall be provided where indicated to receive a DC millivolt input and convert this signal to a 4 to 20 mAdc current output, proportional to the sensed variable. Zero and span adjustment shall be provided. Where the input

signal is a thermocouple, a cold junction reference circuit shall be provided.

- N. Signal Linearizers. Signal linearizers shall be provided where indicated and shall accept a non-linear 4 to 20 mA or other DC signal and provide an output 4 to 20 mA signal proportional to the measured variable. The input signal characteristics shall be as specified in the Schedule or as described in the system functional descriptions. Reference accuracy shall be 2% unless otherwise specified in the Schedule.
- O. Computing Relays. An analog multiplier-divider shall accept three 4 to 20 mAdc signals (A, B, and C) and a manually set constant value (K). It shall perform the computations $Y = K(AB/C)$ where Y is the output value represented by a linear and proportional 4 to 20 mAdc signal. Accuracy of the computation shall be at least plus or minus 0.75% of span with the inputs A and B varying from 10 to 100% of span and input C varying from 10 to 100% of span but not less than 0.4A. An accessible adjustment shall be provided to adjust the value of K from 0.1 to 10. All inputs and outputs shall have zero offset and span adjustments of at least 25% of span.
- P. Ratio Relays. Ratio relays shall accept a 4 to 20 mA signal and output another 4 to 20 mA signal which is the value of the input signal multiplied by a manually set constant (r) plus or minus a manually set constant bias value (B). The value of (r) shall be variable from 0.3 to 3 and B shall be variable from plus or minus 50% of output span. The instrument shall have a reference accuracy of 1% of span including setting of the ratio (r). The indicating scale for (r) shall be in percent unless otherwise shown in the Schedule.
- Q. Analog to Pulse Duration Converters shall accept the specified analog signal and output a pulse duration modulated signal directly proportional to the input. The output shall be a 26 +4 Vdc, signal unless otherwise specified in the Schedule. The converter shall have adjustments for cycle time, span and zero. The "on" time of the output pulse shall increase with the input signal unless "inverted" operation is specified in the Schedule. The ratio of "on" time to "off" time shall be adjustable from 5:1 to at most 2.5:1. The maximum cycle time shall be as shown in the Schedule and shall be adjustable over a minimum range of 5:1. The linearity between input and output shall be at least .25%. Operating power shall be the 120 Vac, 60 Hz for field installation; when panel mounted, power is optional. The enclosure for field mounting shall be NEMA4 or explosion proof (XP) as specified in the Schedule.

- R. Pulse Duration to Current Converters shall accept pulse duration encoded signals and convert them to an equivalent 4-20 mA_{dc} signal. The inputs shall be isolated or grounded contact closures or voltages from 20-30 V_{dc}. The repetition rate shall be 5 or 15 seconds as specified in the Schedule. The maximum on/off time ratio shall be 5: to 1 unless otherwise specified. Linearity of the conversion shall be .25% and zero and span adjustment shall be provided. Field mounted units shall have NEMA 4 rated cases or explosion proof (XP) when specified in the Schedule.
- S. Signal Inverters (Reversers). Inverters shall be provided where indicated in the Schedule or as required to provide specified operation. The inverter shall operate with grounded or isolated 4-20 mA_{dc} inputs and outputs. The output shall be inverted (reversed) from the input, i.e. 20-4 mA_{dc}, and shall be capable of delivering 20 mA into 1,000 ohms.
- T. Pulse Rate Adder.
 - 1. The pulse rate adder shall accept up to 4 simultaneous pulse trains and output a pulse train with a pulse count which is the algebraic (plus or minus) sum of the pulses in the input pulse trains. Pulses shall be 25 milliseconds minimum offtime and of 25 milliseconds minimum duration with an amplitude of 22 to 30 V_{dc}, unless otherwise shown in the Schedule. The load rating shall be 500 mA. The output shall be capable of driving a 24 V_{dc} counter solenoid unless specified otherwise in the Schedule.
 - 2. The unit shall be solid state and designed for behind panel mounting and operate from 120 Vac, 60 Hz commercial power. The adder shall be manufactured by Moore Industries, Automation Associates, or equal.

2.4 RELAYS-ELECTROMAGNETIC

- A. General. Relays shall be provided as necessary to perform switching functions required of control panels and other control circuits. Relays shall be of three types:
 - 1. General Purpose Relays. This type shall be used for logic and switching power to external loads and shall be general purpose industrial types. They shall be of the dust cover enclosed plug-in type with 8 or 11 pin, screw terminal, octal sockets. Relays shall have up to 3 pole form C contacts rated for 10 amperes at 120 Vac and be equipped with neon indicator lamps. Relays shall be as manufactured by General Electric, Square D, Potter-Brumfield, or equal.

2. Logic Switching Relays. This type shall be used for performing logic switching within panels using up to 6 pole form C contacts per coil. These relays shall be of the plug-in telephone type with transparent plastic dust covers and retainer bails or springs. Contacts shall be rated for 5 amperes, suppressed inductive loads, at 28 Vdc or 120 Vac. Relays shall be as manufactured by Potter-Brumfield, IDEC, Automatic Electric, or equal.
3. Non-Load Switching Selector Relays. This type shall be used for high density non-load switching functions such as control buss selection, etc. Where 12 or more related circuits must be switched simultaneously. Up to 48 form C contacts may be operated by a single solenoid coil. Contacts shall be rated to carry 5 amperes at 120 Vac or Vdc. Relays shall be as manufactured by T-Bar, Inc., Westinghouse, or equal. These relays shall be enclosed in dust tight modular assemblies terminated with multi-pin, quick disconnect connectors for modular spare part replacement.

NOTE: This project features Programmable Logic Controllers (PLC's). These PLC's have sufficient rating and capacity to handle any relaying or switching needs for the project. Relays are not to be used without express written consent of the Engineer.

2.5 TIMERS

All timer functions will be performed by the programmable logic controllers.

2.6 ANNUNCIATORS

All windows in the alarm and status annunciator shall be nominally 2-inch by 3-inch, of white plastic, and rear lighted with (2) low voltage, heavy filament lamps. The plastic windows shall be engraved with black letters in accordance with the Schedules or the Drawings. The windows shall be removable from the front for lamp replacement. The lamp units and electronic drivers shall be in one case, unless otherwise approved in writing, with a removable cover and designed for panel mounting. The monitoring modules shall be of all solid state plug-in design. There shall be sufficient electronic modules to drive all required annunciator windows, including spares. When specified, provide repeater contacts terminated on a terminal strip for externally monitoring each alarm status. The annunciator power supply shall be sufficient to drive all required loads. Alarm points shall be driven by modules with the operating sequence shown below. The windows for status indication, when specified shall be off and steady on only,

color shall be white or as shown on the Schedule or the Drawings.

ALARM MODULE OPERATIONAL SEQUENCE

Condition	Display	Audible
Normal	Off	Off
Alert	Flash	On
Silence	Flash	Off
Acknowledge	Steady On	Off
Return to Normal after Acknowledge	Off	Off
Return to Normal before Acknowledge	Flash	On

The alarm and status actuators shall be contacts or as shown on the Drawings. The annunciator shall accept either N.O. or N.C. contacts. The sensing voltage shall not exceed 28 Vdc. The units shall be supplied with audible-flasher cards as required that shall operate on receipt of alarms from any of the alarm points to the panel. A buzzer of approximately 65 dBA at 3 feet shall be provided and mounted in the control panel. An 85 dBA horn in a weather proof housing shall be provided for external mounting when specified in the Schedule. On receipt of any alarm the monitor card shall cause the flasher to flash the appropriate indicating window and sound the alarm.

There shall be a test button, acknowledge button, and an audible silence only button. The test button shall actuate all alarm and status points and sound the audible alarm. The acknowledge and silence buttons shall perform the functions as outlined in the operational sequence, but shall not prevent any future alarm points from being annunciated visually and audibly. The unit shall operate from 120 Vac, 60 Hz commercial power.

A "first out" sequence shall be provided in which the first alarm in a related group, as designated in the Schedule, shall flash red while subsequent alarms in the group shall be non-flashing white. A first out reset button shall be provided for each designated group.

An annunciator panel with first out capability shall be provided for alarms. For status indication individual lights throughout the graphic panel shall be directly driven by the PLC.

The annunciator panel shall be by Rochester Instrument Systems, Beta, Panalarm, Ronan, or approved equal.

2.7 PROGRAMMABLE CONTROLLERS

- A. General. Programmable controllers shall be provided as specified herein and/or on the Drawings. Programmable controllers shall operate to control processes, via electrically operated devices such as solenoid valves, relays, motor starters, power contactors, etc., on the basis of a stored digital program of instructions and various input contacts and switches which provide process condition feedback, and externally selectable manual switches.
- B. Programming Method. The programming method shall be entering ladder logic instructions via an IBM PC compatible programming terminal. The programming software shall be IBM PC compatible and shall include a PID Loop configuration routine to simplify the configuration software shall be Allen Bradley part number 6203-PLC5 or approved equal.
- C. Programming Unit. The programming unit shall be an IBM PC compatible laptop computer. It will use the software specified above. The programming unit shall be furnished by the PLC manufacturer. It shall be capable of programming the PLC over the network communications link. The programming unit shall be an Allen Bradley 1784-T47 or approved equal.
- D. Memory. The memory shall be packaged in the same module with the processor. The memory shall consist of at least 6K words of battery backed RAM memory and 8K words of EPROM memory.
- E. Central Processing Unit. The CPU shall have PID instruction for closed loop operation of multiple continuous built into its firmware. The CPU shall include built-in communication capability. The processors shall be Allen Bradley PLC5/25's or approved equal.
- F. Input/Output. I/O shall be of the universal type. That is it should be the same equipment across a broad range of programmable logic controllers. The I/O shall have sufficient capacity to interface with the process devices directly. This will include motor starters. The use of interposing relays is strictly forbidden.
- G. Power Supplies. Each I/O rack shall have its own power supply. For conformity all racks shall use Allen Bradley 1771-P7 power supplies or approved equal.

2.8 HAND VALVES WITH LIMIT SWITCHES

Hand valves with limit switches shall be Asahi-America ball valves with Westlock SPDT limit switches.

2.9 SCHEDULES

The following schedules are attached at the end of this Section.

- A. Indicator Schedule.
- B. Annunciator Schedule.
- C. Operating Light Schedule.
- D. Digital Indicator Schedule
- E. Nameplate Schedule
- F. Hand Control Valve Schedule

PART III: EXECUTION

3.1 INSTALLATION

Installation, testing, validation, and start-up shall be as specified in Section 17000.

3.2 PROGRAMMING

Arrange for ICM subcontractor to furnish a PLC program which fulfills the requirements specified in specification Sections 17000, 17050, 17100, 17200, 17300; and shown on the P&ID drawings. The ICM subcontractor shall be responsible for the correct operation of the PLC program and the correct operation at those portions of the plant controlled by the PLC.

3.3 START-UP ASSISTANCE

Arrange for the ICM subcontractor to furnish a minimum of 2 weeks start-up assistance for the purpose of debugging the system and training the Buyer's personnel.

END OF SECTION 17200

PROCESS VARIABLE INDICATOR SCHEDULE

Tag No.	Units	Range	Alarm Switches	Nameplate	P&ID
L1-201	Feet	0-9	None	Influent Equalization Tank No. 1	38548-007
L1-202	Feet	0-9	None	Influent Equalization Tank No. 2	38548-007
L1-203	Feet	0-9	None	Ion Exchange Surge Tank	38548-008
L1-204	Feet	0-9	None	Clean Water Storage Tank	38548-009
L1-205	Feet	0-15	None	Effluent Tank No. 1	38548-010
L1-206	Feet	0-15	None	Effluent Tank No. 2	38548-010
L1-207	Feet	0-15	None	Effluent Tank No. 3	38548-010
L1-208	Feet	0-5	None	Caustic Storage Tank	38548-009
L1-209	Feet	0-5	None	Acid Storage Tank	38548-009
L1-210	Feet	0-13	None	Clean Water Storage	38548-009

PROCESS VARIABLE INDICATOR SCHEDULE (Continued)

Tag No.	Units	Range	Alarm Switches	Nameplate	P&ID
T1-201B	Degrees F	0-100	None	Influent Equal Tank No. 1	38548-007
T1-202B	Degrees F	0-100	None	Influent Equal Tank No. 2	38548-007
T1-204B	Degrees F	0-100	None	Clean Water Storage	38548-009
T1-203B	Degrees F	0-150	None	Ion Exchange Surge Tank	38548-008
A1-210	pH	2-14	None	Neutralization Tank	38548-009

ANNUNCIATOR PANEL SCHEDULE

For Annunciator in the MCP

Point No.	Tag No.	Actuator No.	Service Message	Window Color
1	OA-100B	FP-100	Pump P-100 Failure	W
2	OA-101B	FP-101	Pump P-101 Failure	W
3	OA-102B	FP-101	Pump P-102 Failure	W
4	OA-103B	FP-103	Pump P-103 Failure	W
5	OA-104B	FP-103	Pump P-104 Failure	W
6	OA-107B	FP-107	Pump P-107 Failure	W
7	OA-108B	FP-107	Pump P-108 Failure	W
8	LAHH-107	PLC-1	Bldg. 891 Sump High High	W
9	LAH-107	PLC-1	Bldg. 891 Sump High Level	W
10	LAL-107	PLC-1	Bldg. 891 Sump Con Level	W
11	LAHH-201	PLC-1	Influent Equal Tank No. 1 High Level	W
12	LALL-201	PLC-1	Influent Equal Tank No. 1 Low Level	W
13	LAHH-202	PLC-1	Influent Equal Tank No. 2 High Level	W
14	LALL-202	PLC-1	Influent Equal Tank No. 2 Low Level	W

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ANNUNCIATOR PANEL SCHEDULE (Continued)

For Annunciator in the MCP

Point No.	Tag No.	Actuator No.	Service Message	Window Color
15	OA-201	MCC-1	Influent Equal Tank No. 1 Heater Fail	W
16	TAHH-201	PLC-1	Influent Equal Tank No. 1 High Temp	W
17	TALL-201	PLC-1	Influent Equal Tank No. 1 Low Temp	W
18	OA-202	MCC-1	Influent Equal Tank No. 2 Heater Fail	W
19	TAHH-202	PLC-1	Influent Equal Tank No. 2 High Temp	W
20	TALL-202	PLC-1	Influent Equal Tank No. 2 Low Temp	W
21	OA-301	MCC-1	Pump P-301 Failure	W
22	OA-302	MCC-1	Pump P-302 Failure	W
23	LAHH-204	PLC-1	Clean Water Storage High Level	W
24	LALL-204	PLC-1	Clean Water Storage Low Level	W
25	OA-204	MCC-1	Clean Water Storage Heater Failure	W
26	TAHH-204	PLC-1	Clean Water Storage High Temp	W
27	TALL-204	PLC-1	Clean Water Storage Low Temp	W
28	OA-210A	MCC-1	Neutralization Minor Failure	W
29	LAHH-210	PLC-1	Neutralization High Level	W

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ANNUNCIATOR PANEL SCHEDULE (Continued)

For Annunciator in the MCP

Point No.	Tag No.	Actuator No.	Service Message	Window Color
30	OA-210B	MCC-1	Pump P-210 Failure	W
31	LAHH-203	PLC-1	Ion Exch Surge Tank High Level	W
32	LALL-203	PLC-1	Ion Exch Surge Tank Low Level	W
33	OA-203	MCC-1	Ion Exch Surge Tank Heater Fail	W
34	TAHH-203	PLC-1	Ion Exch Surge Tank High Temp	W
35	TALL-203	PLC-1	Ion Exch Surge Tank Low Temp	W
36	ZA-303A	ZS-303A	Emergency Eyewash	W
37	ZA-303B	ZS-303B	Emergency Shower	W
38	LAHH-205	PLC-1	Effluent Tank No. 1 High Level	W
39	LAHH-206	PLC-1	Effluent Tank No. 2 High Level	W
40	LAHH-207	PLC-1	Effluent Tank No. 3 High Level	W
41	Push Buttons	Reset, Test, Acknowledge		
42	LAHH-215	PLC-1	Containment No. 1 High Level	W
43	LAHH-216	PLC-1	Containment No. 2 High Level	W
44	LAHH-217	PLC-1	Containment No.3 High Level	W

OPERATING LIGHT SCHEDULE

For Status Lights in the MCP

Item No.	Tag No.	Color	Service Message
1	OL-100B	G	Recovery Well Pump P-100
2	OL-101B	G	Connection Well Pump P-101
3	OL-102B	G	Connection Well Pump P-102
4	OL-103B	G	Connection Well Pump P-103
5	OL-104B	G	Connection Well Pump P-104
6	OL-105B	G	Connection Well Pump P-105
7	OL-106B	G	Connection Well Pump P-106
8	OL-107B	G	Sump Pump P-107
9	OL-108B	G	Sump Pump P-108
10	ZLO-201A	G	Influent Tank No. 1 Inlet Open
11	ZLC-201A	R	Influent Tank No. 1 Inlet Closed
12	LAH-201	R	Influent Tank No. 1 High Level
13	LAL-201	R	Influent Tank No. 1 Low Level
14	OL-201	G	Influent Tank No. 1 Heater IH-201
15	TAL-201	R	Influent Tank No. 1 Low Temp

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OPERATING LIGHT SCHEDULE (Continued)

For Status Lights in the MCP

Item No.	Tag No.	Color	Service Message
16	TAH-201	R	Influent Tank No. 1 High Temp
17	ZLC-201B	R	Influent Tank No. 1 Outlet Open
18	ZLO-201B	G	Influent Tank No. 1 Outlet Closed
19	ZLO-202A	G	Influent Tank No. 2 Inlet Open
20	ZLC-202A	R	Influent Tank No. 2 Inlet Closed
21	LAH-202	R	Influent Tank No. 2 High Level
22	LAL-202	R	Influent Tank No. 2 Low Level
23	OL-202	G	Influent Tank No. 2 Heater IH-202
24	TAL-202	R	Influent Tank No. 2 Low Temp
25	TAH-202	R	Influent Tank No. 2 High Temp
26	ZLO-202B	G	Influent Tank No. 2 Outlet Open
27	ZLC-202B	R	Influent Tank No. 2 Outlet Closed
28	OL-301	G	Influent Transfer Pump P-301
29	OL-302	G	Influent Transfer Pump P-302
30	ZLO-203A	G	Ion Exchange Surge Tank Inlet Open

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OPERATING LIGHT SCHEDULE (Continued)

For Status Lights in the MCP

Item No.	Tag No.	Color	Service Message
31	ZLC-203A	R	Ion Exchange Surge Tank Inlet Closed
32	LAH-203	R	Ion Exchange Surge Tank High Level
33	LAL-203	R	Ion Exchange Surge Tank Low Level
34	OL-203	G	Ion Exchange Surge Tank Heater IH-203
35	TAL-203	R	Ion Exchange Surge Tank Low Temp
36	TAH-203	R	Ion Exchange Surge Tank High Temp
37	ZLC-203B	R	Ion Exchange Surge Tank Outlet Open
38	ZLO-203B	G	Ion Exchange Surge Tank Outlet Closed
39	ZLO-204A	G	Clean Water Storage Inlet Open
40	ZLC-204	R	Clean Water Storage Inlet Closed
41	LAH-204	R	Clean Water Storage High Level
42	LAL-204	R	Clean Water Storage Low Level
43	OL-204	G	Clean Water Storage Heater IH-204
44	TAL-204	R	Clean Water Storage Temp Low
45	TAH-204	R	Clean Water Storage Temp High

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OPERATING LIGHT SCHEDULE (Continued)

For Status Lights in the MCP

Item No.	Tag No.	Color	Service Message
46	ZLC-204B	R	Clean Water Storage Outlet Open
47	ZLO-204B	G	Clean Water Storage Outlet Closed
48	XL-205A	G	Effluent Storage Tank D-205 Cathodic Protection
49	ZLC-205A	R	Effluent Storage Tank D-205 Inlet Closed
50	ZLO-205A	G	Effluent Storage Tank D-205 Inlet Open
51	LAH-205	R	Effluent Storage Tank D-205 High Level
52	LAL-205	R	Effluent Storage Tank D-205 Low Level
53	ZLC-205B	R	Effluent Storage Tank D-205 Outlet No. 1 Closed
54	ZLO-205B	G	Effluent Storage Tank D-205 Outlet No. 1 Open
55	ZLO-205C	G	Effluent Storage Tank D-205 Outlet No. 2 Open
56	ZLO-205C	R	Effluent Storage Tank D-205 Outlet No. 2 Closed
57	XL-206A	G	Effluent Storage Tank D-206 Cathodic Protection
58	ZLC-206A	R	Effluent Storage Tank D-206 Inlet Closed
59	ZLO-206A	G	Effluent Storage Tank D-206 Inlet Open
60	LAH-206	R	Effluent Storage Tank D-206 High Level

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OPERATING LIGHT SCHEDULE (Continued)

For Status Lights in the MCP

Item No.	Tag No.	Color	Service Message
61	LAL-206	R	Effluent Storage Tank D-206 Low Level
62	ZLC-206B	R	Effluent Storage Tank D-206 Outlet No. 1 Closed
63	ZLO-206B	G	Effluent Storage Tank D-206 Outlet No. 1 Open
64	ZLO-206C	G	Effluent Storage Tank D-206 Outlet No. 2 Open
65	ZLO-206C	R	Effluent Storage Tank D-206 Outlet No. 2 Closed
66	XL-207A	G	Effluent Storage Tank D-207 Cathodic Protection
67	ZLC-207A	R	Effluent Storage Tank D-207 Inlet Closed
68	ZLO-207A	G	Effluent Storage Tank D-207 Inlet Open
69	LAH-207	R	Effluent Storage Tank D-207 High Level
70	LAL-207	R	Effluent Storage Tank D-207 Low Level
71	ZLC-207B	R	Effluent Storage Tank D-207 Outlet No. 1 Closed
72	ZLO-207B	G	Effluent Storage Tank D-207 Outlet No. 1 Open
73	ZLO-207C	G	Effluent Storage Tank D-207 Outlet No. 2 Open
74	ZLC-207C	R	Effluent Storage Tank D-207 Outlet No. 2 Closed
75	ZLC-500	R	Effluent Storage Bypass HV-500 Closed

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OPERATING LIGHT SCHEDULE (Continued)

For Status Lights in the MCP

Item No.	Tag No.	Color	Service Message
76	ZLO-500	G	Effluent Storage Bypass HV-500 Open
77	ZLO-501	G	Effluent Storage Bypass HV-501 Open
78	ZLC-501	R	Effluent Storage Bypass HV-501 Closed
79	ZLO-502	G	Effluent Storage Bypass HV-502 Open
80	ZLC-502	R	Effluent Storage Bypass HV-502 Closed
81	LAH-208	R	Caustic Storage Tank High Level
82	LAL-208	R	Caustic Storage Tank Low Level
83	LAH-209	R	Acid Storage Tank High Level
84	LAL-209	R	Acid Storage Tank Low Level
85	OL-210A	G	Neutralization Tank Mixer
86	LAL-210	R	Neutralization Tank Low Level
87	LAH-210	R	Neutralization Tank High Level
88	OL-210B	G	Neutralization Tank Pump P-210

DIGITAL INDICATOR SCHEDULE

Tag No.	Digital Input	Analog Input	No. of Digits	Digit Height (inch)	Auto Hanging (Yes/No)	Auto Polarity (Yes/No)	Nameplate
FQI-100B	Yes	No	4	1	No	No	P-100 Total Flow
FQI-101B	Yes	No	4	1	No	No	P-101,2 Total Flow
FQI-103B	Yes	No	4	1	No	No	P-103,4 Total Flow

NAMEPLATE SCHEDULE

Tag Number	Service Message
HS-100B	Pump P-100 H-O-A Selector Switch
HS-101B	Pump P-101 H-O-A Selector Switch
HS-102B	Pump P-102 H-O-A Selector Switch
HS-103B	Pump P-103 H-O-A Selector Switch
HS-104B	Pump P-104 H-O-A Selector Switch
HS-201	Heater IH-201 Off-Auto Selector Switch
HS-202	Heater IH-202 Off-Auto Selector Switch
HS-301B	Pump P-301 Auto-Off Selector Switch
HS-302B	Pump P-302 Auto-Off Selector Switch
HS-203	Heater IH-203 Auto-Off Selector Switch
HS-204	Heater IH-204 Auto-Off Selector Switch
HS-210A	Mixer M-210 On-Off Selector Switch
HS-210B	Pump P-210 On-Off Selector Switch

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INSTRUMENT VALVE SCHEDULE

Tag Number	Location
HV-201A	Tank 201
HV-201B	Tank 201
HV-202A	Tank 202
HV-202B	Tank 202
HV-203A	Tank 203
HV-203B	Tank 203
V-204	Tank 204
HV-204A	Tank 204
HV-204B	Tank 204
HV-205A	Tank 205
HV-205B	Tank 205
HV-205C	Tank 205
HV-206A	Tank 206
HV-206B	Tank 206
HV-206C	Tank 206
HV-207A	Tank 207

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INSTRUMENT VALVE SCHEDULE (Continued)

Tag Number	Location
HV-207B	Tank 207
HV-207C	Tank 207
HV-500	Effluent Storage
HV-501	Effluent Storage
HV-502	Effluent Storage

1-8-14

October 4, 1990

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SECTION 17300

PANELS AND CONTROL ROOM HARDWARE

PART I: GENERAL

1.1 DESCRIPTION

This Section covers control panels for work of the ICM Sections, and all unit panels as called for in Division 11 unless modified under other Sections.

1.2 SUBMITTALS

Refer to Section 17000 for required method of preparation and transmittal.

A. Shop Drawings. Submit shop drawings for all control panels, including details for the following items, as applicable:

1. Electric power wiring schematics.
2. Air supply piping schematics.
3. Electric signal wiring schematics.
4. Pneumatic signal tubing schematics.
5. Fabrication drawings.
6. Details of all panel accessories.
7. Listing of all panel mounted (both front and rear) instruments.
8. Panel layouts and nameplate inscriptions.

B. Factory Test Reports. Submit 3 copies of each test result, certified by manufacturer.

1.3 PRODUCT DELIVERY AND HANDLING

Ship assembled control panels in sections that facilitate handling and field installation.

PART II: PRODUCTS

2.1 PANELS

Control panels shall be furnished completely pre-wired, with factory or shop mounted instruments and controls and factory tested prior to shipment.

A. Piping and Wiring within each panel shall be done in a workmanlike manner and grouped and supported to give a neat appearance. All control components not flush mounted on the front of the panel shall be mounted on fully accessible subpanels or racks within the panels for easy removal. All signal lines leaving the panels shall terminate at bulkhead

fittings or terminal blocks and shall be tagged to facilitate field connections.

- B. Size and Supports. Panels shall be of sufficient size to adequately enclose all instruments designated as "panel-mounted" plus ample interior clearance to allow for installation, general servicing, and maintenance of the instruments. Weight of instruments shall be supported by Unistrut, Famet, Caine, or equal channel supports. Panel size when indicated on the drawings shall be adhered to.
- C. Exterior Panel Color shall complement adjacent panels and shall be approved by the Owner.
- D. Attachment methods shall be detailed on panel fabrication drawing submittals. If requested by the Owner, structural calculations for panels shall be furnished. Heavy panels shall be attached by anchor bolts embedded in beams supporting the floor. See the Structural Drawings for location of beams.
- E. Space shall be provided for instruments indicated as furnished by others to be mounted and wired by the control panel manufacturer. These units shall be shipped to the control panel manufacturer in sufficient time for wiring. Coordination of instrument delivery shall be the responsibility of the Contractor. The instruments and controls to be located on each panel are shown on the instrumentation drawings, electrical schematics, and/or in the individual specification.
- F. Switching Circuit Schematics where shown are suggested only. The Contractor may elect to perform the required functions by other standard logic techniques. Components and circuits used shall be subject to review and approval. All switching circuits shall be checked and verified for specified performance by testing before shipment. Non-conforming circuits shall be corrected and retested.

Where reference is made to mechanical equipment Unit Control Panels in the schematics or specifications, the interface with the Division 13 control panels may vary from the circuit indicated because the unit panels are supplied as the manufacturer's standard. The contractor shall adapt the indicated schematic as necessary to provide the indicated functions, limited only by the provided access to the internal circuits of the Unit Control Panel via terminal strips. He shall not modify the Unit Control Panel without supplier's approval.

- G. Control Voltage. The control voltage will be 120 Vac power, as supplied from the power panels supplied under Division 16. Indicating lamps shall be powered from the same 120 VAC power. Defeatable safety interlock switches shall be provided on access doors to disconnect local and foreign voltages only if required by safety codes of applicable regulating authorities.
- H. Identification. All terminals, wires and equipment shall be labeled for easy identification. Each wire shall have a unique number and be labeled at both ends. Terminals and equipment shall be labeled in a clear permanent fashion. Labels shall be attached to the main frame whenever possible in a readily observable position. Each plug-in device and its socket shall both be identified. Where identifying numbers are assigned in the specifications or drawings, they shall not be changed without approval.
- I. Arrangement. Where so indicated, the instruments mounted in the panels shall have the nominal size and general arrangement shown. Panel layouts and nameplates shall conform to the approved submittal.
- J. Louvers shall be provided, when required for cooling, near the bottoms and tops on the rear doors and side of panels. 80-mesh screens shall cover the insides of louvers.

2.2 CONSTRUCTION

Control panels shall be formed of cold-rolled sheet 316 stainless steel of sufficient thickness and with stiffening as required for fabrication, shipping, erection, and service. Panels shall be fully enclosed, including top, with no visible seams on the front. Panel front construction shall be minimum 3/16 inch stretcher-leveled, cold-rolled 316 stainless steel with stiffeners as necessary to maintain a flatness of 1/16-inch of any two-foot span and 1/8-inch over any eight-foot span with all equipment installed. All other sections shall be 12-gage except doors may be minimum 14-gage and shall maintain the same specified flatness when closed and latched. When shown on the drawings, filler panels shall extend to the ceiling.

- A. Cabinets shall be free-standing with adequate internal bracing to support the weight of instruments and wiring. The cabinet design shall be for front or side access only unless a minimum of three feet of clearance is provided for rear access behind as shown on the Plans. Doors shall be key locked with a minimum of two sets of keys supplied. Doors shall be labeled with "AUTHORIZED PERSONNEL ONLY" in one inch letters. When so shown on the plans, panels shall be of the "walk-in" type with a minimum of 36" of clearance for maintenance personnel. Connections to and from the cabinets shall be through conduit through the bottom except when otherwise indicated.

- B. Finish. After fabrication, all external welds must be ground smooth. The entire unit shall be thoroughly degreased, then given a brushed finish inside and out.

2.3 PANEL HARDWARE

All doors shall be set flush with three-point vault type key-locking latches in addition to any required screw clamps. Hinges shall be piano type. All hardware and handles shall be stainless steel.

2.4 PANEL ACCESSORIES.

- A. Relays, timers and other internally mounted equipment shall be of the types specified in Section 13320 of these specifications.
- B. Panel Face Mounted equipment shall be of the types specified in Section 13320 of these specifications.
- C. Selector Switches, Push Buttons and Pilot Lights shall be oil-tight Microswitch types CMC PM and PML, or equal unless specified otherwise in Section 13320.
- D. Panels shall be internally lighted by tubular incandescent lamps, provided with guards and a control switch located convenient to each access door. Two duplex grounded power receptacles, shall be provided in each panel section. The lights and receptacles shall be wired to outgoing terminal blocks for 120-volt, 60-hertz, single phase supply.
- E. Name Plates shall be black lamicaid with minimum 1/4-inch high white letters for major area titles, 3/16-inch for component titles, and 5/32-inch for sub-titles and shall be fastened with a permanent but dissolvable adhesive or by screws.
- F. Terminals. Electrical terminals shall be tubular clamp type with 600-volt barriers. The terminal blocks shall be Phoenix USK-4, Allen Bradley 1492-142, or Weidmuller SAX 2.5.
- G. Wiring may be bundled and laced or tied with plastic ties and supported to prevent sagging or damage during shipment. If preferred, wiring may be enclosed in plastic wireways, in which case it need not be laced inside the wireway. All wiring shall be made with Flame-Retardent EP Insulation, Type NSIS, stranded Copper Conductor, 600 volts, 90°C, minimum #14 AWG. Each terminal shall be identified on the marker strip with a number neatly printed in ink. Where wires are terminated on screw terminals, insulated crimped spade lugs shall be used. 120 Vac wiring shall be color coded with black for unswitched hot or power, red - switched hot or control, white - neutral, green - ground. Signal wiring shall use an established color coding scheme. Submit for approval. Wiring shall have permanent markers at each end. Except as otherwise

stated herein, Division 16 General Electrical Requirements shall apply.

- H. Pneumatic Tubing may be copper, aluminum, or polyethylene as preferred by the panel vendor, except that the air header, valves, and fittings shall not be polyethylene. Tubing shall be 1/4-inch O.D. with a working pressure rating of at least 150 psi. Threaded fittings which hold air shall be assembled with bias-cut Teflon tape lubricant. Polyethylene tubing shall be supported in plastic duct to within one foot of each termination and shall be color coded in accordance with ISA Recommended Practice RP7.2. Where less than eight airheader take-offs are required provide individual combination air filter regulators with gauge for each air consuming device.
- I. Pneumatic Piping shall be PVC and shall incorporate sufficient unions for assembly and disassembly. The Contractor shall supply 100 psig dried plant air to the panels requiring air. The control panels shall incorporate all the necessary pressure-reducing valves and adapters for the instrumentation air piping. Piping shall be installed in accordance with the standards of ISA.
- J. Circuit breakers shall be provided for power connections to the panel.
- K. Inputs and outputs shall be individually fused.
- L. 20% spare I/O shall be provided. The spares shall be terminated in terminal strip and labeled as such.
- M. Analog inputs and outputs are to have both conductors fused.
- N. The main control panel is to be a graphic panel measuring 90 inches high, 96 inches wide, and 30 inches deep.

PART III: EXECUTION

3.1 INSTALLATION

Installation, testing, calibrations, validation, startup, and instructions shall be in accordance with Section 17000.

END OF SECTION 17300

SECTION 17550

AUTOMATIC TELEPHONE DIALER

PART 1: GENERAL

1.1 DESCRIPTION: Requirements of Conditions of the Contract, Division 1 and Section 17000 form a part of this Section. This Section specifies the instruments and equipment to perform the required functions in conjunction with information and equipment specified in other Sections of Division 17. Schedules where required for equipment appear at the end of this Section. These shall not be construed as complete bills of material.

- A. Unit Responsibility: It shall be the responsibility of the ICM Subcontractor as described in Section 17000 of this Division to insure that the instruments and equipment furnished under this Section are compatible with the equipment furnished under Sections of this Division and other Divisions of these Specifications, and that the signal transmission methods are compatible.
- B. Case colors shall be compatible with panel colors and subject to final approval by the Buyer. Normally, compatible standard colors of the manufacturer shall be acceptable.

1.2 QUALITY ASSURANCE

- A. Manufacturer: In addition to requirements of Section 17000, instrumentation and control equipment furnished shall be manufactured by a firm regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the most recent design.

1.3 REFERENCE STANDARDS

- A. Rocky Flats Plant Standard No. SE-550.

PART 2: PRODUCTS

2.1 AUTOMATIC TELEPHONE DIALER

- A. General Description: The telephone dialer system shall monitor operations in an unmanned facility where in the event of an alarm condition indicated by remote contact operations, the dialer system shall automatically initiate contact with preset telephone numbers to advise of an alarm condition. The telephone dialer system shall communicate in

voice format. The advisory message shall define the location of the emergency and the nature of the alarm condition.

- B. Capacity for Monitoring: The dialer system shall be capable of receiving input contact operations from up to four (4) independent sources, as shown on the Drawings. Contact operation shall be either NC or NO and be jumper or switch selectable. The dialer system shall be capable of reporting in a single telephone call the existence of one or a multiple number of alarm conditions.
- C. Capacity for Dialing: The dialer system shall be capable of dialing up to four (4) telephone numbers. The dialer system shall have the capacity to use up to sixteen (16) digits to define the telephone number.

For example, the dialer system shall be capable of dialing one or more numbers to connect itself to an "outside" line, followed by "1" if required, plus area code in three digits if required, and finally, a standard seven-digit telephone number.

- D. Telephone Line Requirements: The dialer system shall use standard telephone lines. Systems which require dedicated telephone lines or other specialized telemetering methods are not acceptable.
 - 1. Installation of the dialer system shall be readily achieved by plugging the dialer directly into a modular jack supplied as a part of a normal telephone line installation.
 - 2. It is desirable, not essential, that the dialer system be compatible with a telephone installation which will permit inclusion of a standard telephone handset at the monitoring station. Such an arrangement shall permit personnel to make outgoing telephone calls without interference with the dialer system installation.
 - 3. The dialer system shall include the telephone line coupler required by the Federal Communications Commission. Preference will be given to those dialer systems which contain the coupler as an integrated portion of the dialer itself.
- E. Programming: The dialer system shall be equipped with a keyboard to enter telephone numbers to be dialed and the sequence in which the dialing procedure shall be executed.

Subsequent alterations to the telephone numbers or the sequence in which they are called shall be entered by the same keyboard.

Messages shall be similarly programmed by entering 2 digit numbers for the selected words from a list of 100 words.

The dialer system shall incorporate a playback feature which permits the person establishing the program of telephone numbers to confirm that the data stored in the dialer system's program is correct. This confirmation shall be achieved by the ability of the dialer system to enunciate through an audio speaker located on the front panel of the system the complete series of telephone numbers and their calling sequence. Controls located on the keyboard shall make this confirmation procedure available at any time. Other controls located on the keyboard shall be available to initiate a test-run of the dialer system's complete alarm advisory operation, including optionally the actual telephone dialing process.

- F. Identification of Dialer: In reporting an alarm the dialer system shall be required to identify itself by "Station Number" from which the receiving person can deduce its geographical location.

To this end, the dialer system shall be equipped with manually operated switches which can be used to set the station identification number. Two digits minimum shall be used. These switches shall be readily accessible and shall be alterable without need for tools.

G. Operation:

1. The dialer system shall proceed to deliver its alarm message a minimum of sixteen (16) times, pausing at the completion of each message to permit the receiving person to acknowledge by pressing a tone button on the touch-tone type phone.
2. If acknowledgement is not received on the first telephone call because the telephone receiving the call did not answer or the receiving party did not acknowledge, the dialer system shall terminate the first call by hanging up. The system shall wait approximately sixty (60) seconds before proceeding to the next telephone number. The dialer shall repeat the cycle, continuing indefinitely until the alarm problem is eliminated or the dialer system is turned off entirely at the site.
3. The format of the alarm message to be delivered by the dialer system shall contain sufficient vocabulary to

identify the location of the dialer system and the nature of the alarm.

- H. Optional Acknowledgement Generator: Where the receiving telephone uses a rotary dialing mechanism, the supplier of the subject dialer system shall make available at optional extra cost a battery-powered handheld tone generator. The output audible tone signal from this device shall provide the signalling acknowledgement when it is directed into the telephone handset mouthpiece.
- I. Electrical Power Requirements: The dialer system shall operate from standard electric power utilities furnishing 120 Vac, 60 Hz, single-phase service. The dialer system shall be furnished with an integrally-mounted rechargeable dc battery power supply which shall automatically serve the system in event of failure of commercial power for a period of not less than twenty-four (24) hours continuously. Restoration of the ac power source shall restore the battery to full capacity through use of a float-charging circuit included in the system. The dialer shall automatically initiate the calling sequence in case of an ac power failure.
- J. Construction: The housing for the dialer system shall be UL-listed, heavy gauge steel, fiberglass or aluminum. Access to controls shall require opening of a hinged door. Connections for alarm-signalling inputs, electrical power and telephone shall be located on the lower side of the housing and shall accommodate standard electrical conduit fittings in three separate ports.
- K. Temperature Compatibility: The dialer system shall be tested and guaranteed for performance in ambient temperatures ranging between 0 to 120 degrees F.
- L. Manufacturer: The dialer system shall be of a quality equal to that manufactured by Butler National Corporation, Microtel Inc, or equal.

PART 3: EXECUTION

- 3.1 Installation, testing, validation, and start-up shall be as specified in Section 17000. The automatic telephone dialer shall be installed to monitor and respond to alarm signals shown on the Process and Instrumentation Diagram as specified in Section 17000.

END OF SECTION 17550

17550-4

**CONSTRUCTION MANAGEMENT PACKAGE
FOR THE
PHASE IIA CONSTRUCTION
(REMEDIAL ACTION 881, PROCESS TREATMENT SYSTEM)
ROCKY FLATS PLANT
GOLDEN, COLORADO**

Prepared for
EG&G ROCKY FLATS, INC.

DECEMBER 1990

Prepared by
ENGINEERING-SCIENCE, INC.

In Conjunction with
**THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA**

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QUALITY ACCEPTANCE CRITERIA CHECKLIST (QACC)

(PER FACILITIES ENGINEERING PROCEDURE NO DES-18)

MWO/AUTH NO. 986147

BLDG. 891

JOB TITLE Building 881 Hillside Remedial Action, Phase IIA PROJECT ENGR Mike Freehling

EXT. 7743 DATE 12-21-90

ITEM/DESCRIP.	ACCEPTANCE CRITERIA	RESP DEPT	DATE COMPLETED	PASS FAIL	INSP INIT	REMARKS
1. Health Sciences Measures	*Sec. 01106 a, c	ER				*Phase IIA Specifications
2. Trench Safety	*Sec. 02200-1.2B OSHA 29CFR 1926P	FI				
3. Backfill Compaction	*Sec. 02200-3.1F 3.8A&B ASTM D-698, D-1557, D-1556, & D-2922	FI				
4. Concrete Formwork	*Sec. 03100-1.3 OSHA 29CFR 1926.701	FI				
5. Concrete Formwork Design	*Sec. 03100-3.1 ACI Standard 347	FI				
6. Concrete Reinforcement	*Sec. 03200-1.3A 2.1 ACI Standard 315	FI				
7. Concrete	*Sec. 03300-1.4CZ ACI Std. 211.1, 306, 318, 304, ASTM C-150, C-33, C-260, D-1752, C-171, C-309	FI				
8. Grout	*Sec. 03601-2.1 ASTM C-150, C-33	FI				
9. Paint	RFP Standard SC-110 *Sec. 09900-1.1	FI				
10. Fire Protection System	RFP Standard SF-100 *Sec. 11110 NFPA Pamphlet No.10	FI				

QUALITY ACCEPTANCE CRITERIA CHECKLIST (QACC)

(PER FACILITIES ENGINEERING PROCEDURE NO DES-18)

MWO/AUTH NO. 986147

BLDG. 891

JOB TITLE Building 881 Hillside Remedial Action, Phase IIA

PROJECT ENGR Mike Freehling

EXT. 7743 DATE 12-21-90

ITEM/DESCRIP.	ACCEPTANCE CRITERIA	RESP DEPT	DATE COMPLETED	PASS FAIL	INSP INIT	REMARKS
11. First Aid Equipment	*Sec. 11110 OSHA 29CFR 1910	FI				*Phase IIA Specifications
12. Equipment Leveling	*Sec. 15050-3.1F ASME B.5.16	FI				
13. Piping - DWPP CPVC galv. steel	RFP Std SP-211, SP-220(3.8, 3.43, 3.50)	FI				
	SP-301, SC-107	FI				
14. Pipe and Tank Insulation	RFP Standard SP.401 *Sec. 15180-2.1 to	FI				
	2.4, ASTM E-84 E-89, E-96, D-1056	FI				
	B-209, UL-723	FI				
15. Electrical Tests	*Sec. 16010-3.2	FI				
16. Electrical Motors	*Sec. 16150-1.1, 1.2 NEMA Standard	FI				
17. General Electric	RFP Std. SE-103, SE-104, SE-112, SE-114, and SC-107 *Sec. 16050-1.1, 2.3 3.6, NEC UL Listed	FI				
18. Electrical Panel Boards	*Sec. 16160 NEC UL Listed	FI				
19. Electrical Grounding	*Sec. 16450-1.2 NEC, IEEE 142, UL Listed	FI				

COMPONENT CHECKOUT
PHASE IIA
881 HILLSIDE REMEDIAL ACTION

COMPONENT	CHECKOUT SATISFACTORILY		CHECKERS INITIALS	DATE
	YES	NO		
<u>Mixers</u>				
M209 Neutralization Mixer				
<u>Pumps</u>				
P210 Neutralization Effluent Pump				
107 Sump Pump				
108 Sump Pump				
P301 UV Transfer Pump				
P302 UV Transfer Pump				
<u>Valves</u>				
HV201A Ball Valve				
HV201B Ball Valve				
HV202A Ball Valve				
HV202B Ball Valve				
HV203A Ball Valve				
HV203B Ball Valve				
HV204A Ball Valve				
HV204B Ball Valve				
HV205A Ball Valve				
HV205B Ball Valve				
HV205C Ball Valve				
HV206A Ball Valve				
HV206B Ball Valve				
HV206C Ball Valve				
HV207A Ball Valve				
HV207B Ball Valve				
HV207C Ball Valve				
HV208A Ball Valve				
HV208B Ball Valve				
HV208C Ball Valve				
HV209A Ball Valve				
HV209B Ball Valve				

COMPONENT CHECKOUT

GENERIC PROCEDURES

HOW TO TEST

WHAT TO LOOK FOR

MOTORS -

- * "Bump" motor by turning power on to the motor and then quickly turning off.

- * Ensure that shaft is rotating in proper direction and that couplings (if any) are properly connected.

- * UV/Peroxide System
(follow manufacturer's instructions)

- * Ion Exchange System
(follow manufacturer's instructions)

SECTION 3
SYSTEMS OPERATIONAL TEST
PROCEDURES FOR
BUILDING 881 HILLSIDE REMEDIAL ACTION
PHASE IIA CONSTRUCTION

SYSTEMS OPERATIONAL TESTS PROCEDURES
BUILDING 881 HILLSIDE REMEDIAL ACTION
PHASE IIA CONSTRUCTION

Approved for release:

Building 891 Operations	_____	_____
		Date
Building 891 Utilities	_____	_____
		Date
Facilities Engineering	_____	_____
		Date
HS&E Area Engineer	_____	_____
		Date

SYSTEMS OPERATIONAL TEST PROCEDURE
BUILDING 881 HILLSIDE REMEDIAL ACTION
PHASE IIA CONSTRUCTION
TESTING CERTIFIED AS COMPLETE

I. EG&G

Construction Management _____

Facilities Quality Assurance _____

Waste Operations _____

Facilities Project Management _____

Facilities Engineering _____

II. DEPARTMENT OF ENERGY _____

SYSTEMS OPERATIONAL TEST PROCEDURES
BUILDING 881 HILLSIDE REMEDIAL ACTION
PHASE IIA CONSTRUCTION

1.0 INTRODUCTION

1.1 General Description. A groundwater collection, treatment and infiltration system has been constructed to collect contaminated groundwater from the Building 881 Hillside area, treat it with an ultraviolet light-hydrogen peroxide and ion exchange treatment process. The system consists of:

- A. A French drain groundwater collection system;
- B. Two sump pump installation in the drain to deliver water to the treatment unit storage tanks;
- C. A well which intercepts shallow contaminated water and delivers it to the treatment unit storage tanks;
- D. Building 891 drain sump pump which intercepts the foundation drainage and delivers it to the treatment unit storage tanks;
- E. Four 15,000 gallon influent storage tanks with level measurement and freezing protection;
- F. A pre-engineered ultraviolet light-hydrogen peroxide and ion exchange treatment system housed in Building 891;
- G. Three 144,000 gallon effluent storage tanks;
- H. A discharge system.

The S.O. Test for Phase IIA facilities includes D, E, F, and G above.

2.0. INSTRUCTIONS

2.1 RESPONSIBILITIES

- A. Waste Operations will assign a responsible Testing Engineer to obtain all necessary permits and safety reviews and conduct the SO Test.
- B. Facilities Engineering Project Engineer will witness the SO Test and issue appropriate Engineering Orders (EO's) or Field Change Orders (FCO's) to correct any deficiencies found during the SO Test.

2.2 TEST DATA

- A. Perform an "On-the-Job" safety review and complete Form RF-13010, Rev 2166 MHS-16-2.4, "Work Permit."
- B. Record all required test data on the Systems Operational (SO) test sheets during the equipment testing.
- C. Log sheets generated during the SO test are retained and filed with the user's copy of the SO test.
- D. Contact the responsible Testing Engineer if improper response is obtained during the testing.

2.3 SAFETY

- A. Safety related paperwork is retained and filed with the master copy. This paperwork includes, but is not limited to, vessel entry permits, work permits, etc. If numerous copies are identical, such as work permits, one copy is filed with the master copy with a notation of the number of identical copies generated.
- B. Assure adequate shut down of equipment at the end of the test.
- C. A red tag is used to indicate equipment malfunction.
- D. All testing activities are accomplished in accordance with the EG&G Health, Safety & Environment Manual.

2.4 PERFORMANCE ACCEPTED

- A. Performance acceptance of each piece of equipment, valve, pump, etc., is indicated on the SO test sheet. The responsible engineer dates and initials each test sheet in the "Remarks" column when the work described is completed and accepted.

2.5 PERFORMANCE NOT ACCEPTED

- A. Responsible Testing Engineer contacts Construction Management and explains the deficiency. Construction Management places a red tag on the equipment and transmits deficiency information to Facilities Project Management.

2.6 EXCEPTIONS-RECOMMENDATIONS

- A. Exceptions are defined as equipment deficiencies found when comparing equipment performance with equipment design specifications and drawings. When exceptions are identified, they are listed, dated, and initialed on the SO test form. The responsible engineer notifies Construction Management that

tested equipment is not accepted and a Construction Management representative attaches a red tag to the equipment. The red tag remains on the equipment until the exception is resolved.

- B. Exception resolutions are listed on the SO test form with initials and date of resolution.
- C. Recommendations are defined as equipment deficiencies that were not covered by the design criteria but are considered necessary for the completion of a safe, efficient system.
- D. Testing Team observations and recommendations are defined in a letter to the Project Engineer. This letter is distributed after testing results are finalized and the Facilities Engineering Manager has approved the letter. This letter defined the recommendations as equipment deficiencies, betterments, and safety considerations for safe and efficient operation of the system.

2.7 MASTER COPY

- A. When testing is completed, the original test sheets are replaced with work copies containing test results. The finished document contains the typed tests and handwritten test data, notations, exceptions, deficiency corrections, and supplemental paperwork generated during the test.
- B. The finalized master copy and associated documents are transmitted to Facilities Quality Assurance where it is placed on permanent file with other project files and information. Copies, one each, are distributed as follows:

Construction Management;
Waste Operations;
Facilities Project Management;
Facilities Engineering;
Department of Energy.

3.0 GENERAL REQUIREMENTS

Reviewed, Initial
Checked, &/or &
Completed Date

- A. Read this entire SO Test Procedure () _____
- B. Review P&ID sheets 38548-006, () _____
007, 008, 009, 010
- C. Become familiar with equipment, piping, and
instrumentation of the system () _____

D. Check the following items:

1. Electrical power ready for use () _____
2. All instruments have been calibrated
and are ready for use () _____
3. Potable water ready for use () _____
4. UV/Peroxide treatment unit and Ion Exchange
treatment unit are installed and
functional per manufacturer () _____
5. Turn all valves, pumps and treatment
units off () _____

4.0 TEST PROCEDURES

The following test procedures will be performed, initialed, and dated. Tests number 1 through 13 verify the operation of instrumentation and mechanical equipment. Test number 14 verifies the operation of the PLC.

Test No. 1 - Building 891 Sump Pump Operation and Instrumentation

Scope: This test demonstrates the operation of the Building 891 sump pumps (P-107, P108) and associated instrumentation.

Prerequisites:

- Power to P-107, and P108
- Water in the collection sump
- Completed installation of Building 881 Hillside Remedial Action Phase IIA Construction

Test Procedures:

Step 1 - Visual Inspection

initials date

- _____ 1. Verify that all system components are installed per the System Drawing including liquid level instrumentation, pump motor controls, and valves.

Step 2 - Pump Operation Check

initials date

- _____ 1. Verify operation of pumps (P-107, and -108) by opening the following valves as required

<u>To Test Pump</u>	<u>Open Values</u>
P-107	HV-107
P-108	HV-108

In addition, Valve HV-201A or HV-202A must be open to test each pump. Be sure that the influent tank (T-201 or T-202) is ready to accept water. Place switch HS-107 and -108 in the hand position to test each pump in turn.

- _____ 1. Verify operation of the alternate circuit which should switch the lead and lag pump after each use and on pump failure.

Step 3 - Instrumentation check

initials date

- | | | |
|-------|-------|-------------------------------------------------------------------------------------------------------------------------|
| _____ | _____ | 1. Verify operation of P-107 and -108 status indication locally (OL-107A and -108A) and at the MCP (OL-107B and -108B). |
| _____ | _____ | 2. Verify operation of pump failure alarm locally (OA-107A and -108A) and at the MCP (OA-107B and -108B). |
| _____ | _____ | 3. Verify operation of water level elements (LE-107) and indicating transmitters (LIT-107). |

Test No. 2 - Influent Storage Tanks

Scope: This test demonstrates the operation of the influent storage tank instrumentation (T-201 and T202).

Prerequisites:

- Power to MCP
- Water in T-201 and T-202
- Completed installation of Building 881 Hillside Remedial Action Phase IIA Construction

Test Procedures:

Step 1 - Visual Inspection

initials date

- _____ 1. Verify that all system components are installed per the System Drawings including liquid level instrumentation, temperature instrumentation, heaters, and valves.

Step 2 - Instrumentation Check

initials date

- _____ 1. Verify operation of water level elements (LE-201 and LE-202) and indicating transmitters (LIT-201 and LIT-202).
- _____ 2. Verify operation of local tank temperature indicators (TI-201A and TI-202A) and tank temperature transmitters (TT-201 and TT-202).
- _____ 3. Verify operation of valve position switches (ZSH-201A, -201B, -202A, -202B, ZSL-201A, -201B, -202A, -202B).
- _____ 4. Verify operation of moisture detection in double wall pipe from collection well system (MA-400).
- _____ 5. Verify operation of tank heaters IH-201 and IH-202.

Test No. 3 - UV/Peroxide Feed Pumps

Scope: This test demonstrates the operation of the UV/Peroxide Feed Pumps (P-301 and P-302) and associated instrumentation.

Prerequisites:

- Water in tank T-201 or T-202
- Power to MCP, P-301, and P-302
- Completed installation of Building 881 Hillside Remedial Action Phase IIA Construction
- UV system ready to accept flow
- T-203 ready to accept flow

Test Procedures:

Step 1 - Visual Inspection

initials date

- _____ 1. Verify that all system components are installed per the System Drawings including pumps, valves, and motor controllers.

Step 2 - Pump Operation Check

initials date

- _____ 1. Verify operation of pumps (P-301 and P-302) by opening valves HV-201B or HV-202B and the inlet valve to the pump to be tested (HV-301A or HV-302A) and the effluent valve from the pump to be tested (HV-301B and HV-302B). The UV/Peroxide system must also be ready to accept water, valve HV-203A must be open and T-203 must be ready to accept water. Operate each pump in turn by putting HS-301A or HS-302A in the JOG position.
- _____ 2. Verify operation of the pump indication lights at the MCP (OL-301 and OL-302)

Test No. 5 - Ion Exchange Surge Tank

Scope: This test demonstrates the operation of the ion exchange surge tank (T-203) instrumentation.

Prerequisites:

- Power to MCP
- Completed installation of Building 881 Hillside Remedial Action Phase IIA Construction
- Water in T-203

Test Procedures:

Step 1 - Visual Inspection

initials date

- _____ 1. Verify that all system components are installed per the System Drawings including liquid level instrumentation, temperature instrumentation, heaters, and valves.

Step 2 - Instrumentation Check

initials date

- _____ 1. Verify operation of water level element (LE-203) and indicating transmitter (LIT-203).
- _____ 2. Verify operation of local tank temperature indicator (TI-203A) and tank temperature transmitter (TT-203).
- _____ 3. Verify operation of valve position switches (ZSH-203A, -203B, ZSL-203A, -203B).
- _____ 4. Verify operation of tank heater IH-203.

Test No. 7 - Chemical Storage and Feed Systems

Scope: This test evaluates the operation of the HCl and NaOH feed and storage systems for use in the ion exchange resin regeneration and spent regenerant neutralization.

Prerequisites:

- Power to P-208 and P-209
- Completed installation of Building 881 Hillside Remedial Action Phase IIA Construction

Test Procedures:

Step 1 - Visual Inspection

initials date

- _____ 1. Verify that all system components are installed per the System Drawing including liquid level instrumentation, valves, pumps, and pump controls.

Step 2 - Pump Operation Check

initials date

- _____ 1. Verify operation of pump P-208 by opening valves HV-208A and HV-208B and closing valves HV-208C and HV-208D. Connections should be made to the bulk delivery connection so that tap water can be pumped from a clean 55 gal. drum. Tank T-208 must be ready to accept liquid. Upon completion of the pump test all piping as well as tank T-208 should be drained.
- _____ 2. Repeat 1 above for pump P-209.

Step 3 - Instrumentation check

initials date

- _____ 1. Verify operation of the P-208 & P-209 status indication (OL-208 A&B, OL-209 A&B).
- _____ 2. Verify operation of the P-208 and P-209 pump failure alarms (OA-208A & B and OA-209A &B).

Test No. 8 - Clean Water Storage Tank

Scope: This test demonstrates the operation of the clean water storage tank (T-204) instrumentation and valve (V-204).

Prerequisites:

- Power to MCP
- Completed installation of Building 881 Hillside Remedial Action Phase IIA Construction

Test Procedures:

Step 1 - Visual Inspection

initials date

- _____ 1. Verify that all system components are installed per the System Drawings including liquid level instrumentation, temperature instrumentation, heaters, and valves.

Step 2 - Instrumentation Check

initials date

- _____ 1. Verify operation of water level element (LE-204) and indicating transmitter (LIT-204).
- _____ 2. Verify operation of local tank temperature indicator (TI-204A) and tank temperature transmitter (TT-204).

Step 3 - Valve Operation

initials date

- _____ 1. Verify operation of Valve V-204.

Test No. 9 - Effluent Storage Tanks

Scope: This test demonstrates the operation of the effluent storage tanks instrumentation (T-205, T-206, and T-207).

Prerequisites:

- Power to MCP
- Completed installation of Building 881 Hillside Remedial Action Phase IIA Construction

Test Procedures:

Step 1 - Visual Inspection

initials date

- _____ 1. Verify that all system components are installed per the System Drawings including liquid level instrumentation, temperature instrumentation, and valves.

Step 2 - Instrumentation Check

initials date

- _____ 1. Verify operation of water level elements (LE-205, LE-206 and LE-207) and indicating transmitters (LIT-205, LIT-206, and LIT-207).
- _____ 2. Verify operation of valve position switches (ZSH-205A, -205B, -206C, -206A, -206B, -206C, -207A, -207B, -207C, -205A, -205B, -205C, -206A, -206B, -206C, -207A, -207B, -207C, ZSH-500, -501, -5-2, ZSL-500, -501, -502).

Test No. 10 - Neutralization Tank

Scope: This test demonstrates the operation of the neutralization tank (T-210) instrumentation and pump (P-210).

Prerequisites:

- Power to MCP & P-210
- T-210 ready to accept water
- Completed installation of Building 881 Hillside Remedial Action Phase IIA Construction

Test Procedures:

Step 1 - Visual Inspection

initials date

- _____ 1. Verify that all system components are installed per the System Drawings including liquid level instrumentation, temperature pH instrumentation, mixers, pump and valves.

Step 2 - Instrumentation Check

initials date

- _____ 1. Verify operation of water level element (LE-210) and indicating transmitter (LIT-210).
- _____ 2. Verify operation of pH instrumentation (AE/AT-210).
- _____ 3. Verify operation of the pressure indicator (PI-210).

Step 3 - Pump check (P-210)

initials date

- _____ 1. Verify operation of P-210 by pumping tap water from T-210 to the process waste system. Add tap water to T-210 and open HV-210A & B. Also open HV-210C a HV-210D as appropriate.

Test No. 11 - Emergency Eye Wash

Scope: This test demonstrates the operation of the valve position indicators on the emergency eye wash and safety shower in building 891.

Prerequisites:

- installation of eyewash and safety shower

Test Procedures:

Step 1 - Visual Inspection

initials date

- _____ 1. Verify that all equipment is installed per the system drawings including eyewash, safety shower, and instrumentation.

Step 2 - Instrumentation Inspection

initials date

- _____ 1. Verify operation of the valve position indicators (ZS-303A, ZS-303B).

Test No. 12 -Programmable Logic Controller (PLC) Operation and Master Control Panel (MCP) instrumentation

Scope: This test demonstrates the ability of the PLC to perform the required control of the system, and the operation of the MCP instrumentation.

Prerequisites:

- Power to PLC & MCP
- Completed programming of PLC
- Completed installation of Building 881 Hillside Remedial Action Phase IIA Construction

Test Procedures:

Step 1 - Visual Inspection

initials date

1. Verify that all system components are installed per the System Drawing.

Step 2 - Well Pump Control

initials date

1. Test the status of P-100 with the following combinations of positions of HS-100A and HS-100B.

		<u>HS-100A</u> <u>Position</u>	<u>HS-100B</u> <u>Position</u>	<u>Required</u> <u>Status of</u> <u>P-100</u>
_____	_____	AUTO	AUTO	Controlled by PLC
_____	_____	AUTO	OFF	OFF
_____	_____	OFF	AUTO	OFF
_____	_____	OFF	OFF	OFF
_____	_____	JOG	AUTO	ON
_____	_____	JOG	OFF	ON

2. With P-100 under PLC control verify that P-100 is on when LSH-100 indicates a high level in the well and none of the conditions in number 4 below are met.

- _____ 3. With P-100 under PLC control verify that P-100 is off when LSL-100 indicates a low level in the well and none of the conditions in number 4 below are met.
- _____ 4. Verify that P-100 cannot be started by the PLC if any of the following conditions exist:
- _____ a. HV-201A and HV-202A are both closed (as indicated by ZSL-201A and ZSL-201B, respectively);
- _____ b. HV-201A is open (ZSH-201A) and T-201 is full (LSH-201);
- _____ c. HV-202A is open (ZSH-202A) and T-202 is full (LSH-202);
- _____ d. there is a complete system shutdown.

Step 3 - Collection Sump Pump Control

initials date

1. Test the status of P-101, -102, -103, -104, -105, and -106 with the following combinations of positions of HS-10XA and HS-10XB (where X = 1 to 6).

	<u>HS-10XA</u> <u>Position</u>	<u>HS-10XB</u> <u>Position</u>	<u>Required</u> <u>Status of</u> <u>P-10X</u>
_____	AUTO	AUTO	Controlled by PLC
_____	AUTO	OFF	OFF
_____	OFF	AUTO	OFF
_____	OFF	OFF	OFF
_____	JOG	AUTO	ON
_____	JOG	OFF	ON

- _____ 2. With the collection sump pumps under PLC control verify that the lead pump is on when the respective LSH-10X indicates a high level in the well and none of the conditions in number 4 below are met.

- _____ 3. With the collection sump pumps under PLC control verify that the pumps are off when the respective LSL-10X indicates a low level in the well and none of the conditions in number 4 below are met.
- _____ 4. Verify that P-10X cannot be started by the PLC if any of the following conditions exist:
- _____ a. HV-201A and HV-202A are both closed (as indicated by ZSL-201A and ZSL-201B, respectively);
- _____ b. HV-201A is open (ZSH-201A) and T-201 is full (LSH-201);
- _____ c. HV-202A is open (ZSH-202A) and T-202 is full (LSH-202);
- _____ d. there is a complete system shutdown.
- _____ 5. Verify that the alternator circuits switch the lead and lag pumps after each use and on pump failure.

Step 4 - Building 891 Sump Pump Control

initials date

1. Test the status of P-107 & P-108 with the following combinations of positions of HS-107 and HS-108

	<u>HS-10X Position</u>	<u>Required Status of P-10X</u>
_____	AUTO	Controlled by PLC
_____	OFF	OFF
_____	HAND	ON

- _____ 2. With the pumps under PLC control verify that the lead pump is on when LSH-107A indicates a high level in the sump and none of the conditions in number 4 below are met. Verify that the lag pump also is on when LSH-107B indicates a High High level.
- _____ 3. With the pump under PLC control verify that both the lead and lag pumps are off when LSL-107 indicates a low level in the sump and none of the conditions in number 4 below are met.

- _____ 4. Verify that P-107 or P-108 cannot be started if any of the following conditions exist:
- _____ a. HV-201A and HV-202A are both closed (as indicated by ZSL-201A and ZSL-201B, respectively);
- _____ b. HV-201A is open (ZSH-201A) and T-201 is full (LSH-201);
- _____ c. HV-202A is open (ZSH-202A) and T-202 is full (LSH-202);
- _____ d. there is a complete system shutdown.
- _____ 5. Verify that the alternator circuits switch the lead and lag pumps after each use and on pump failure.
- _____ 6. Verify the activation of the automatic telephone dialer on a high-high sump level (LSHH-107).

Step 5 - Influent Storage Tank Control

initials date

- _____ 1. Verify level indication at LI-201, LI-202.
- _____ 2. Verify that a high level indication at LSHH-201 or LSHH-202 activates the high-high level alarm (LAHH-201 or LAHH-202) and activates the automatic telephone dialer.
- _____ 3. Verify that a low-low level condition (LSLL-201 or LSLL-202) prevents the heating element in the corresponding tank from operating.
- _____ 4. Verify that a high-level condition (LSH-201 or LSH-202) prevents pumps P-100 through P-108 from operating when the corresponding tank-inlet valve is open (HV-201A or HV-202A). Also actuate the high-level alarm (LAH-201 or LAH-202).
- _____ 5. Verify that a low-level condition (LSL-201 or LSL-202) prevents pumps P-301 and P-302 and the UV/peroxide treatment unit from operating when the corresponding tank-outlet valve is open (HV-201B or HV-202B). Also activate the low-level alarm (LAL-201, LAL-202).

- _____ 6. Verify operation of tank-temperature indication TI-201B and TI-202B.
- _____ 7. Verify that a high-high or low-low temperature condition (TSHH-201, TSHH-202, TSLL-201, TSLL-202) activates the corresponding alarm (TAHH-201, TAHH-202, TALL-201, TALL-202) and the automatic telephone dialer.
- _____ 8. Verify operation of corresponding tank heating element on low-temperature condition (TSL-201, TSL-202) and shut off of heating element on high-temperature condition (TSH-201, TSH-202).

Step 6 - Influent Transfer Pumps

initials date

- _____ 1. Verify that P-301 or P-302 are controlled by the PLC when the corresponding hand-control switch (HS-301B or HS-302B) is in the AUTO position.
- _____ 2. Verify that JOG/OFF/AUTO switches HS-301A and HS-302A override the PLC control regardless of the position of HS-301B and HS-302B.
- _____ 3. Verify that P-301 or P-302 are turned off by the PLC when any of the following are true:
 - _____ a. Low level in T-201 or T-202 when the corresponding tank outlet valve (HV-201B, HV-202B) is open;
 - _____ b. Low level in T-205, T-206, or T-207 when the corresponding tank recycle valve (HV-205C, HV-206C, HV-207C) and UV/peroxide recycle valve (HV-501) are open;
 - _____ c. High level in T-203 when the tank inlet valve (HV-203A) is open;
 - _____ d. UV/peroxide recycle valve (HV-501) open, but none of the tank recycle valves (HV-205C, HV-206C, HV-207C) or the effluent recycle valve (HV-500) are open;
 - _____ e. T-203 inlet valve (HV-203A) closed;
 - _____ f. T-201 and T-202 outlet valves (HV-201B, HV-202B) and UV/peroxide recycle valve (HV-501) all closed;

- _____ g. Shutdown of UV/peroxide treatment unit initiated by the treatment unit ICM system.

Step 7 - UV/Peroxide Treatment System Control

Scope: The SO test procedures for the UV/peroxide treatment system PLC will be provided by the manufacturer.

Step 8 - IX Surge Tank Control

initials date

- _____ 1. Verify level indication at LI-203.
- _____ 2. Verify that a high level indication at LSHH-203 activates the high-high level alarm (LAHH-203) and activates the automatic telephone dialer.
- _____ 3. Verify that a low-low level condition (LSLL-203) prevents the heating element from operating.
- _____ 4. Verify that a high-level condition (LSH-203) prevents pumps P-301, P-302, and the UV/peroxide treatment unit from operating. Also activate the high-level alarm (LAH-203).
- _____ 5. Verify that a low-level condition (LSL-203) prevents the IX treatment unit from operating. Also activate the low-level alarm (LAL-203).
- _____ 6. Verify operation of tank-temperature indication TI-203.
- _____ 7. Verify that a high-high or low-low temperature condition (TSHH-203, TSLL-203) activates the corresponding alarm (TAHH-203, TALL-203) and the automatic telephone dialer.
- _____ 8. Verify operation of corresponding tank heating element on low-temperature condition (TSL-203) and shut off of heating element on high-temperature condition (TSH-203).

Step 9 - Ion Exchange Treatment System Control

Scope: The SO test procedures for the Ion Exchange treatment system.
PLC will be provided by the manufacturer.

Step 10 - Chemical Storage and Feed System Control

initials date

- | | | |
|-------|-------|------------------------------------------------------------------------------------------------------------------------------------|
| _____ | _____ | 1. Verify the operation of the low-level switches (LSL-208 and LSL-209) and operation of the low-level alarms (LAL-207 & LAL-208). |
| _____ | _____ | 2. Verify the operation of the high level switches (LSH-208 and LSH-209). |
| _____ | _____ | 3. Verify that a high level condition activates alarms LAH-208 and LAH-209. |

Step 11 - Clean Water Storage Tank Control

initials date

- | | | |
|-------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| _____ | _____ | 1. Verify level indication at LI-204. |
| _____ | _____ | 2. Verify that a high level indication at LSHH-204 activates the high-high level alarm (LAHH-204), closes value V-204, and prevents the IX system from operating. |
| _____ | _____ | 3. Verify that a low-low level condition (LSLL-204) prevents the heating element from operating. |
| _____ | _____ | 4. Verify that a high-level condition (LSH-204) close value V-204. Also activate the high-level alarm (LAH-204). |
| _____ | _____ | 5. Verify that a low-level condition (LSL-204 or LSL-202) prevents the clean water transfer pump from operating. Also activate the low-level alarm (LAL-204). |

- _____ 6. Verify operation of tank-temperature indication TI-204B.
- _____ 7. Verify that a high-high or low-low temperature condition (TSHH-204, TSLL-204) activates the corresponding alarm (TAHH-204, TALL-204) and the automatic telephone dialer.
- _____ 8. Verify operation of the tank heating element on low-temperature condition (TSL-204) and shut off of heating element on high-temperature condition (TSH-204).

Step 12 - Effluent Storage Tank Control

initials date

- _____ 1. Verify level indication at LI-205, LI-206 and LI-207.
- _____ 2. Verify that a high level indication at LSHH-205, LSHH-206 or LSHH-207 activates the high-high level alarm (LAHH-205, LAHH-206, or LAHH-207) and activates the automatic telephone dialer.
- _____ 3. Verify that on high level (LSH-205, LSH-206, LSH-207) the ion exchange treatment unit is prevented from operating when the corresponding tank inlet valve (HV-205A, HV-206A, HV-207A) is open.
- _____ 4. Verify that low level (LSL-205, LSL-206, LSL-207) the corresponding alarms are activated (LAL-205, LAL-206, LAL-207). In addition verify that:
 - _____ a. If the tank is being recycled for processing through the UV/peroxide treatment unit via pumps P-301 or P-302 (HV-501 and HV-205C, HV-206C, or HV-207C open), the pumps and the treatment unit are prevented from operating;
 - _____ b. If the tank is being recycled for processing through the ion exchange treatment unit (HV-502, and HV-205C, or HV-207C open) the ion exchange treatment unit is prevented from operating.
- _____ 5. Verify that the ion exchange treatment unit is prevented from operating under the following conditions:

- _____ a. All tank inlet valves (HV-205A, HV-206A, HV-207A) and effluent recycle valve (HV-500) closed, or if the tank inlet valve is open on a tank which is at high level (LSH-205, LSH-206, LSH-207);
- _____ b. Tank inlet valve (HV-205A, HV-206A, HV-207A) and outlet valve (HV-205B, HV-206B, HV-207B) are open on the same tank;
- _____ c. Ion exchange recycle valve (HV-502) is open, but none of the tank recycle valves (HV-205C, HV-206C, HV-207C) or the effluent recycle valve (HV-500) are open;
- _____ d. Tank is being recycled for processing (HV-502 and HV-205C, HV-206C, or HV-207C open), and the tank is at low level (LSL-205, LSL-206, LSL-207).
- 6. Verify that pumps P-301 and P-302, and the UV/peroxide treatment unit are prevented from operating under the following conditions:
 - _____ a. UV/peroxide recycle valve (HV-501) is open, but none of the tank recycle valves (HV-205C, HV-206C, HV-207C) or the effluent recycle valve (HV-500) are open;
 - _____ b. Tank is being recycled for processing (HV-501 and HV-205C, HV-206C, or HV-207C open), and the tank is at low level (LSL-205, LSL-206, LSL-207).

Step 13 - Neutralization System

initials date

- _____ 1. Verify level indication (LI-210).
- _____ 2. Verify that a low level (LSL-210) prevents P-210 from operating and activates an alarm (LAL-210).
- _____ 3. Verify that at high level (LSH-210) the ion exchange treatment unit receives a signal to stop regeneration and an alarm is activated (LAH-209).

SECTION	DESCRIPTION	a. Shop Drawings	b. Catalog Data	c. Equipment List	d. Material List	e. Elementary Diagrams & Wiring Diagrams	f. Installation Instructions	g. Maintenance Instructions	h. Operating Instructions	i. Samples, Colors	j. Certifications	k. Performance Curves	l. Design Data	m. Recommended Spare Parts List	n. Computations	o. Theory of Operation	p. Demolition	q. Material Safety Data Sheets	r. Other
01610	Mat'l Handling & Waste Disposal																	X	X
03200	Concrete Reinforcement	X																	
05400	Lightgage Framing		X			X													
05500	Structural & Miscellaneous Steel	X	X			X													
08100	Hollow Metal Doors & Frames	X	X	X	X														
08700	Hardware and Specialties		X	X	X														
09900	Painting				X	X			X										
15050	Equipment Installation	X				X	X	X											
15060	Piping and Appurtenances	X	X	X	X	X				X	X	X							
15099	Process Valves, Regulators, and Miscellaneous Components	X	X		X	X	X	X	X		X		X						
15140	Pumps	X	X		X	X	X	X	X		X	X	X	X					
15150	Neutralization and Chemical Storage Tanks	X			X					X	X	X							
15180	Pipe Insulation	X	X																
15221	Mechanical Mixer	X	X	X	X	X	X	X	X		X	X	X	X					
16150	Electrical Power Equipment	X	X	X	X	X	X	X	X		X	X	X	X					
16510	Lighting Fixtures			X															
16610	Cathodic Protection System	X	X	X	X	X	X	X	X		X	X	X	X					
16700	Heat Tracing	X	X			X	X					X	X						
16770	Life Safety Disaster Warning Systems	X	X	X							X								
17000	Gen'l Instrumentation, Control and Monitoring	X	X	X	X	X	X	X	X		X	X	X	X					
17300	Panels & Control Room Hardware	X	X	X	X	X					X								